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Magnetic Hardening of Metals

After the Cloudburst Process, a newly discovered series of phenomena sets in which raises some perplexing questions

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READERS of *American Machinist* are familiar with the Cloudburst Process for superhardening steel (*AM*—Vol. 72, page 917) in which hard steel balls, generally 3 mm. or ⅛ in. in diameter are caused to fall from a height of four meters at the rate of about half a million a minute and bombard hard steel articles placed in the shower. The result of this process is a great increase in hardness of articles so treated (cutting tools, automobile parts, and others). It appears to be a true work-hardening process, but the remarkable discovery has been made that when the cloudburst is stopped, the hardening does not stop. The steel continues to increase in hardness for several hours afterwards, and in some cases, this spontaneous after-hardening is even greater than the hardening immediately caused by the bombardment of the steel balls.

It was inevitable that such a remarkable phenomenon should give rise to speculation as to its cause. A mental picture was called forth of the atoms of steel, originally arrayed in regular rows and layers known as a space lattice, being disarranged by the bombardment, and then when it ceased, proceeding to rearrange themselves, not necessarily in the original layers, but in some new formation whose nature was unknown but which was characterized by increased hardness. The atoms in hard steel are probably crowded, and it seemed likely that in trying to get into their new positions, they would jostle and impede each other to some extent. Was it possible to help them to rearrange themselves?

With this end in view, an experiment was tried. A piece of steel which had been superhardened by cloudburst was magnetized by placing it across the poles of a very strong electro-magnet. It was then turned at right angles so that what had been its North and South poles became East and West, and this change of position was repeated until the steel had been rotated, in contact with the magnet poles, 50 times in one direction and then 50 times in the opposite direction. The result of this process was found to be a very considerable increase of hardness. By dragging the atoms around magnetically, they had been assisted to find the new positions towards which they had been making their way during the previous spontaneous hardening. At least, this explanation appeared plausible.

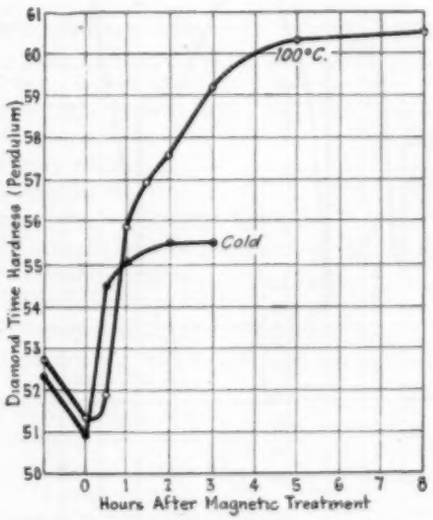


Fig. 1—The subsequent age hardening of high-speed steel is greater when it is magnetically treated at 100 deg. C. then when treated cold

Although the success of this experiment, which was repeated on quite a variety of superhardened steels, appeared to justify the mental picture of crowded atoms edging their way past each other, and assisted in their progress by the rotating magnetic field, it must not be supposed that this picture is a full and accurate representation of the real state of affairs. Indeed, the later experiments which will be described, have clearly shown that the atomic rearrangement is something much more complicated than the mere movement of the atoms into new positions, while the atomic disturbance, which results from magnetizing steel and then changing the direction of its polarity, is of a character not yet understood by physicists. The familiar phenomenon of magnetization is in fact almost as obscure as the still more familiar phenomenon of gravitation.

The magnetic hardening of superhardened steel accomplished, an endeavor was made to apply the same process to other metals in which there was reason to suspect atomic instability—a tendency for

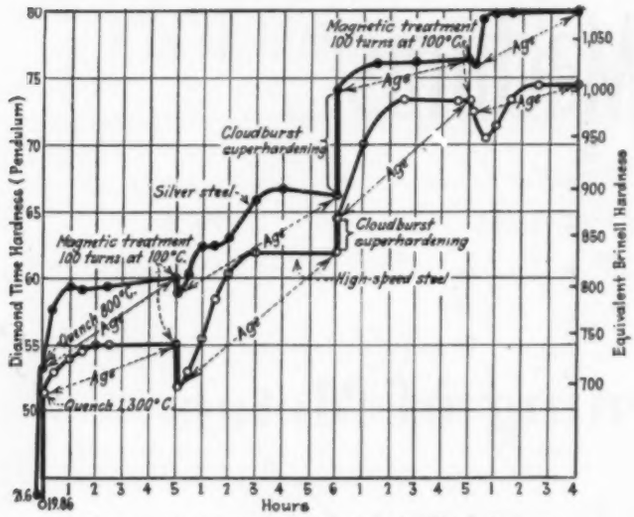


Fig. 2—High-speed steel and "silver" steel were subjected to the following sequence: quenching, aging, magnetic treatment, aging, cloudburst, aging, second magnetic treatment, and aging again

the atoms to rearrange themselves so as to cause an increase of hardness. The two metals which first suggested themselves in this connection were freshly quenched duralumin, which has the well known property of age hardening, and freshly quenched tool steel.

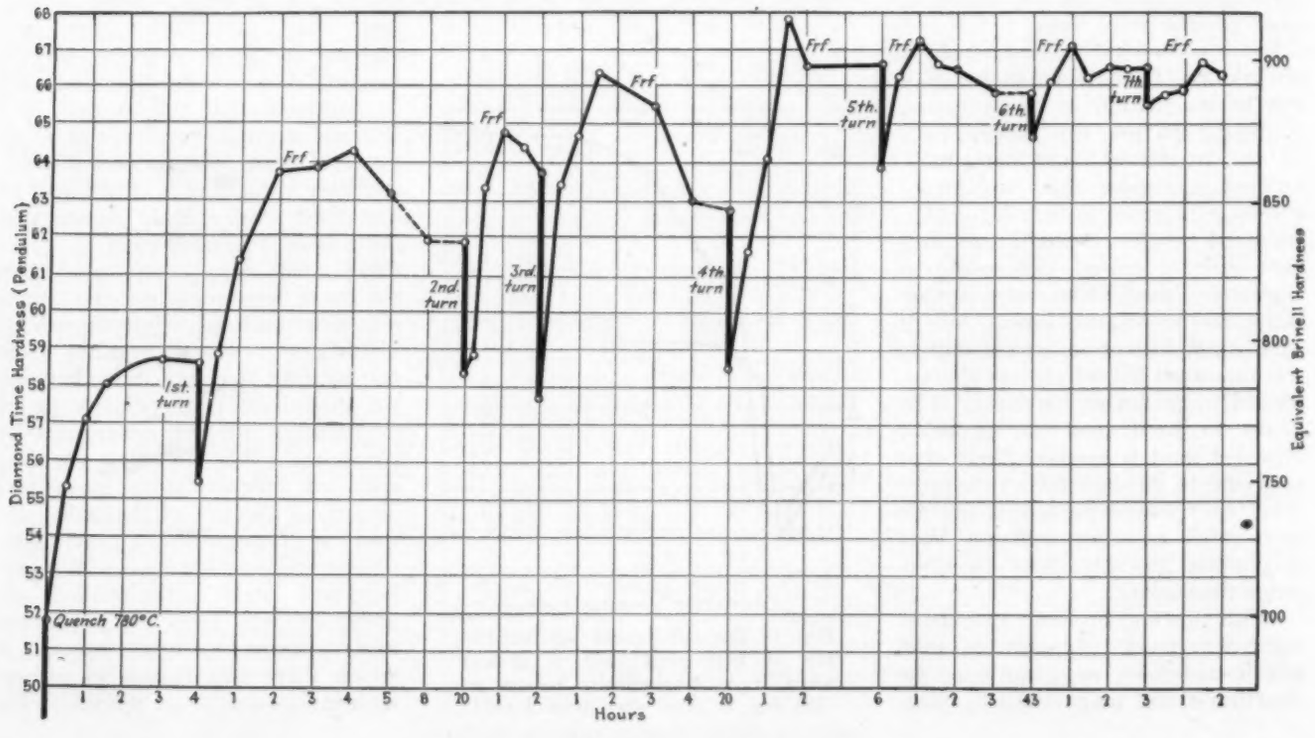
It is a fact fairly familiar to toolmakers that if a tool such as a drill or sawblade has been warped in hardening, it can be straightened by bending immediately after the hardening process, but that in the course of a few hours, it sets and becomes so rigid that any attempt to straighten it is unavailing. This fact appeared to indicate some kind of atomic rearrangement, analagous to that which takes place in superhardened steel. Hardness tests, made immediately after quenching and repeated at intervals of a few minutes for several hours, showed conclusively that in both plain carbon steel and high-speed steel, there is a marked increase of hardness during two or three hours after quenching.

The treatment of rotation in a strong magnetic field was then applied to a variety of steels which had been hardened by quenching and aged for a few hours. There was a marked change of hardness in almost every instance, but the results of these experiments during a period of nearly two years continued to be baffling. Generally the hardness increased, but the increase was so variable in amount that no definite result could be predicted, while in many cases, there was an actual softening instead of a hardening. When the magnetic treatment was applied a second time to the same specimen, the change of hardness, which almost always occurred, was still more uncertain.

At last, the key to the mystery was found, almost by accident. A die of high-speed steel had been treated magnetically, and was found to be much softer than before the treatment. The result was carefully noted as one of the failures, and the specimen was put aside. Then, some months later, a piece of high-speed steel being required for some purpose, this particular specimen was turned up. It was recognized as the one that had been softened magnetically, but to make sure, it was tested again with the Pendulum. Judge the writer's surprise when he found that the specimen was exceptionally hard, much harder in fact than it had been either before or after the magnetic treatment was applied.

This was immediately recognized as a clue to be followed, and it quickly led to the solution which had been so long sought. The magnetic treatment does not simply harden or soften, but sets going a complicated sequence of hardness changes, comprising both softening and hardening, which can only be followed by a succession of

Fig. 3—The chart shows the effect of treating carbon steel (0.76 C., 0.59 Mn., 0.15 Si.) as follows: quenching from 780 deg. C., aging, and turning once in a magnetic field at 100 deg. C The last two processes were repeated six times



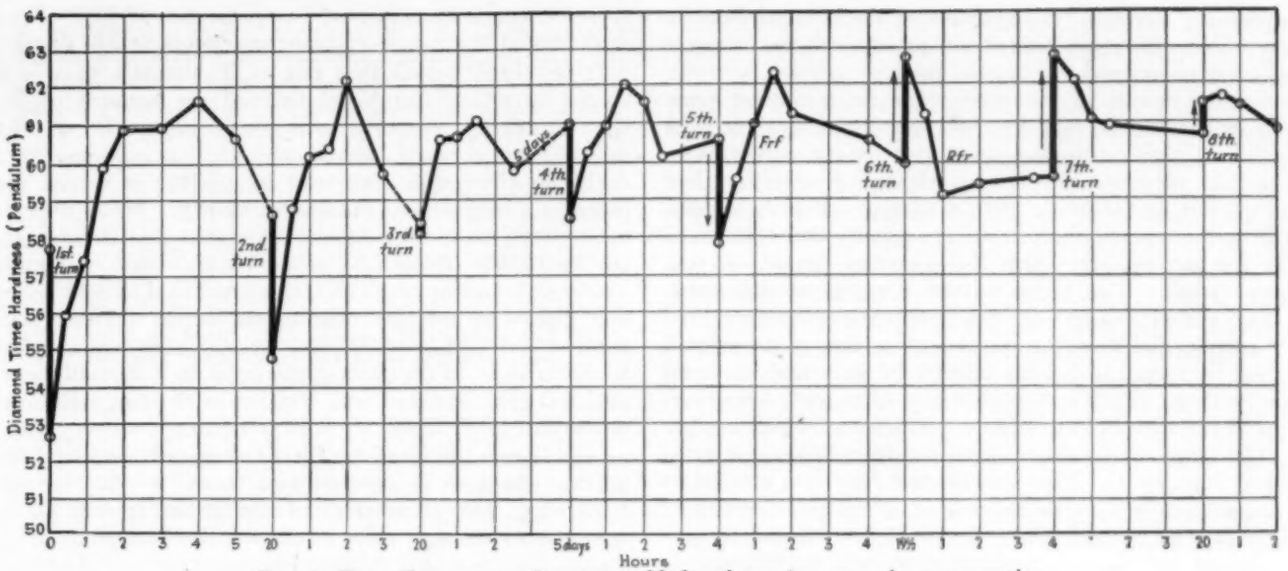


Fig. 4—The effect on a safety razor blade of turning once in a magnetic field at 100 deg. C. followed by aging cold, and repeating seven times

hardness tests made at short intervals of time and continued during many hours or even days or weeks. The discovery of this important principle rendered all the following work comparatively easy.

Fig. 1 shows the sequences of hardness changes in two specimens, cut from a high-speed steel sawblade, which had been normally hardened many months previously. Each was given 100 turns in the magnetic field and tested for hardness immediately and at frequent intervals during a period of aging. In each case, there was an immediate softening followed by a prolonged hardening.

It will be observed that one specimen in Fig. 1 was treated cold and the other hot. The latter was rotated at the bottom of a thin aluminum vessel fixed to the poles of the magnet and filled with boiling water. Many experiments had shown that the magnetic hardening of tool steel is more effective at 100 deg. C. than at room temperature, but later investigation indicates that somewhat higher temperatures give still more favorable results, the best temperature depending on the characteristics of the steel.

Fig. 5 shows the combined effects of quenching, magnetic treatment, and cloudburst treatment, followed in each case by aging, on two specimens, one of high-speed steel, containing eighteen per cent tungsten, and the other of "silver steel" believed to contain 0.80 per cent carbon and a small amount of tungsten. These results were included in a paper presented by the writer to the Royal Society in January, 1931. The high-speed steel specimen was quenched in oil from 1,300 deg. C. and the silver steel in water from 800 deg. C. The curves show the increase of hardness which occurred in each during the first few hours after quenching. The magnetic treatment, 100 turns in the magnetic field in boiling water, resulted in each case, in an immediate softening followed by a spontaneous hardening for 3 to 4 hours. The same specimens were then given the cloudburst treatment, which resulted in an immediate hardening and a further spontaneous hardening during aging. It was this age hardening after cloudburst which first suggested the idea of the magnetic process. A second magnetic treatment was then given and resulted as before in a decrease and then an increase of hardness.

A very strange feature of the magnetic process is the effect of repetition. In all the early experiments, the specimen was rotated 100 times in the magnetic field, but later it was found that the effect of a single turn was practically identical with that of 100 turns, provided the 100 turns were continuous and not interrupted by a period of aging. The effect of interrupted treatment is shown in Fig. 3. In this case, a plain carbon steel (0.76 carbon, 0.59 manganese, 0.15 silicon) was quenched in water from 780 deg. C. and aged until the spontaneous after-hardening ceased. It was then rotated once only in the vessel of boiling water attached to the magnet, and aged again. This treatment resulted in an immediate fall in hardness followed by a spontaneous rise during four hours and a slight fall. This sequence of hardness changes is called a "fall-rise-fall," or by the notation that has been adopted for convenience, "Frf," the capital letter denoting the change which took place during the actual magnetic treatment and the small letters the subsequent changes. The same process of single turns at 100 deg. and aging was repeated seven times, and in each case, resulted in the same Frf

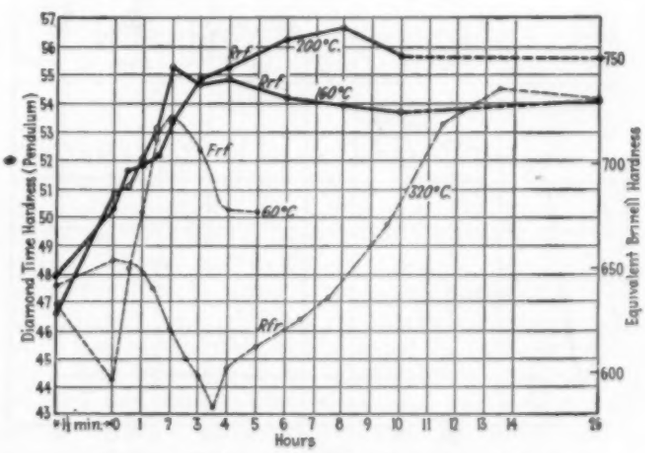


Fig. 5—High-speed steel, when rotated in a magnetic field and aged, undergoes a remarkable series of changes which are greatly affected by the temperature during magnetic treatment

sequence. Though the amplitude of the changes became much less, the aging was more rapid, and there was a progressive general rise in hardness.

Similar results of repeated magnetic treatment (one turn in the field at 100 deg. followed by aging) are seen in Fig. 4, applied in this case to a safety razor blade. The Frf sequence occurred as before in the first five cycles, but in the sixth cycle a change suddenly occurs. The sequence now becomes Rfr, exactly the reverse of the former sequence, and this reversal persists in the later cycles. The cause of the reversal is unknown; indeed the whole of these phenomena are probably caused by atomic changes, the nature of which is at present veiled in mystery, but the change of sequence has been met with so often and in so many different connections that it must be held to have an important significance.

The magnetic treatment hitherto described was carried out at 100 deg. C. This temperature had been arbitrarily chosen because it could be easily applied and maintained by means of boiling water, and had been found to give a greater increase of hardness than cold treatment.

Experiments were now made on hardened high-speed steel at various temperatures, the aluminum bath being filled with water, oil, or fused salt, according to the temperature under investigation. The specimen was given one slow rotation, occupying about one and a half to two minutes, in the magnetic field at the bottom of the bath. Many experiments have been made, and Fig. 5 will indicate the general character of the results. It shows the changes of hardness resulting from magnetic treatment at 60 deg., 160 deg., 200 deg., and 320 deg. C. respectively. The most remarkable feature of these curves is the change of sequence with the change of temperature of the treatment. The specimen treated at 60 deg. gave the Frf sequence seen in Figs. 3 and 4. In the specimens treated at 160 deg. and 200 deg., a new sequence Rrf appears. This sequence will be referred to later. It is in some respects the most important of the three sequences hitherto referred to, and it will be seen that the greatest ultimate increase of hardness occurred in the specimen treated at 200 deg. The specimen treated at 320 deg. gave the reversed sequence Rfr which had previously been found in the razor blade, Fig. 4, in the sixth and subsequent cycles. The same reversed sequence occurred in specimens of high-speed steel treated at a range of temperatures above 240 deg. C.

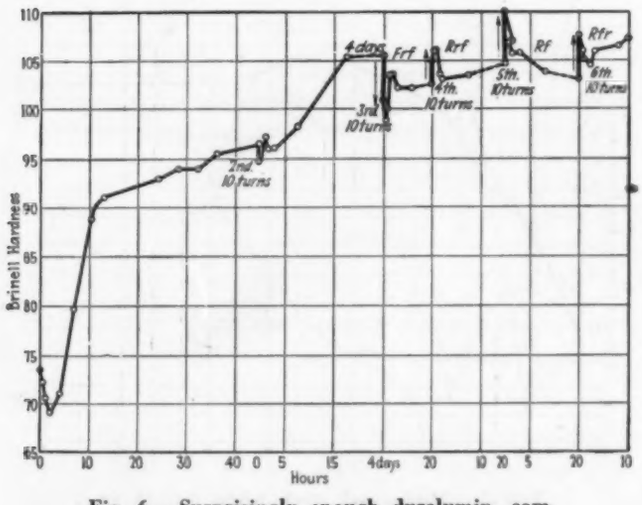


Fig. 6 — Surprisingly enough duralumin, commonly regarded as non-magnetic, responds to magnetic treatment. The sequence of hardness changes is illustrated

It has been stated that one of the metals to which special attention has been directed on account of its age hardening property was duralumin. It seemed unlikely that a metal, usually regarded as non-magnetic, could be affected in any way by placing it across the poles of a magnet and rotating it slowly. Many experiments were made with duralumin, and at first these were, for the reason stated, of a somewhat elaborate character. The metal, freshly quenched, was immersed in cold water and placed in a high-frequency induction furnace. In another series of experiments, the specimen was coupled to the spindle of an electric motor or to a specially constructed gear box and was whirled in the magnetic field at speeds from 2,000 to 20,000 r.p.m. In every case, an effect was produced on the hardness of the metal, its general character being first a softening or retarded age hardening, then an accelerated age hardening and finally a slight softening. The effect was in fact that which might be expected if the Frf sequence of hardness changes were superimposed on the normal age hardening of duralumin. Later experiments showed that all the elaborations of high frequency and high speed were unnecessary. The effect was quite as marked if the duralumin specimen was placed cold across the poles of the magnet and slowly rotated a few times with the fingers.

In this connection, it may be well to mention that duralumin is not actually non-magnetic, as was shown by the following simple experiment: A needle of duralumin 1 in. long and $\frac{1}{8}$ in. square in section was attached to a cork and was floated in a shallow bath of water placed above the magnet. The needle immediately took up a position over the gap between the pole pieces and pointing across the lines of force. Duralumin is in fact diamagnetic. A compass needle of this metal, if very delicately suspended, would point East and West. Similar experiments made with the brass specimens referred to later showed that they were paramagnetic. They pointed along the lines of force or North and South like a steel magnet.

Fig. 6 shows the changes in hardness of a specimen of duralumin freshly quenched from 500 deg. C., then rotated slowly ten times in the magnetic field, and afterwards aged with frequent hardness tests. First there is a fall in hardness, then a rise, the normal age-hardening being frequently accelerated. When the ten turns were repeated, a fall-rise-fall sequence of changes occurred, which on the fourth repetition became rise-rise-fall, and on the sixth repetition rise-fall-rise.

Fig. 7 shows similar effects produced in brass. Two specimens were used. One, a sheet brass, was whirled in the magnetic field at 2,000 r.p.m. which resulted in the Frf sequence of changes. The other specimen was of rod brass which was slowly rotated ten times, this treatment being repeated four times. The three sequences of hardness change Frf, Rrf, and Rfr occurred as in the duralumin. It will be recognized that the first and last of these sequences are the same which occurred in the razor blade, Fig. 4, while all three sequences occurred, in the same order, in the high-speed steel treated at rising temperatures, Fig. 5.

It has been possible to bring forward only a very small part of the accumulated evidence on the effects of the rotating magnetic field, but enough has been said to serve as an introduction to a subject of great theoretical interest and almost unlimited practical possibilities. On

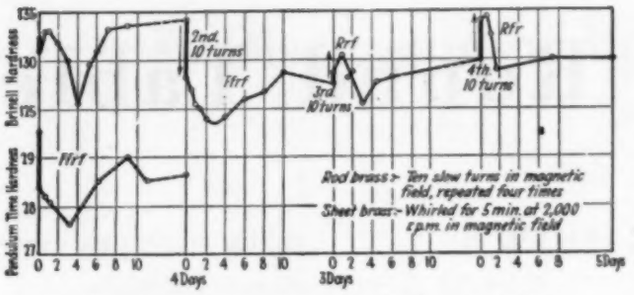


Fig. 7—Magnetic treatment also has its influence on brass. The upper curve shows the hardness variation in rod brass and the lower that in sheet brass

the theoretical aspect of the subject, not much can be said at present with any degree of assurance. The phenomena are clearly atomic in character, and in this respect must be regarded as belonging to that fundamental metallurgy, some of whose manifestations are part of the every-day experience of the engineer, such as the hardening which takes place when metals are cold worked and the further hardening which occurs when they are annealed at very moderate temperatures. That the effect of the rotating magnetic field can be a mere translation or rearrangement of atoms seems at present unlikely. A series of three or four, and sometimes as many as six alternating changes of hardness extending over many hours could scarcely be thus accounted for. The atom is known to be an electrical structure, a planetary system of electrons whirling round a central nucleus. To anyone acquainted with the elements of electro-magnetism, it can scarcely be surprising that such an electrical system should be affected by a violent mag netic disturbance such as has been used in these experiments. If it should be finally established that the observed changes in hardness are symptomatic of changes in the internal structure of the atoms, whether to periodic fluctuations in the orbits of the electrons or otherwise, it may be anticipated that analogous changes may be produced by similar means in the atoms of non-metallic substances. Experiments which are in progress may serve to confirm this view. In any case, it may be confidently anticipated that the newly discovered phenomena will receive the attention of atomic physicists, and will thus extend knowledge in that branch of science.

Among the practical applications of the new magnetic process the most obvious is that of increasing the hardness of hard steel. It was shown in Fig. 5 that an increase of diamond-time hardness from 47.9 to 55.5 (equivalent to Brinell 645 to 750) was effected in high-speed steel by a magnetic treatment carried out at a temperature of 200 deg. C. and occupying only one and a half minutes, exclusive of the necessary period of aging during which the hardness increased spontaneously. This treatment can obviously be applied to tools of any degree of complication, milling cutters, drills, hacksaws, and so forth, and need not be confined to engineers' tools, while the possibilities of its application to hard steel parts other than tools are unlimited. Only slight changes have so far been produced in the hardness of non-ferrous metals, and the corresponding changes, useful or otherwise, in the physical properties of these metals have yet to be investigated. Striking results have been obtained by magnetically treating unhardened steels, but much further research is needed in this branch of the subject.

Reference has already been made to the Cloudburst process of superhardening. Wonderful results have been obtained by that process, quite apart from its well-known applications as a hardness test, in increasing wear resistance in automobile parts and in increasing the durability of cutting tools. The question naturally arises, "What is the relation between these two very different processes for attaining a similar end?" A great deal of patient and systematic research will be necessary before this question can be answered fully. Each process will eventually establish itself in some particular department. At present, it must suffice to say that the increase of hardness produced by Cloudburst bombardment is greater than that which it has been possible so far to produce by magnetic hardening, but as shown in Fig. 2, the two processes can be used in conjunction to produce a degree of hardness unattainable by either process alone.

Experiments have been made in the measurement of hot hardness of tool steels treated by both processes, separately and in combination, hot hardness being the property of retaining hardness at high temperatures which is the basis of efficiency of all high-speed and high-production cutting tools. It has ben found that both the hardness induced by bombardment and that induced by the rotating magnetic field are retained at temperatures which would suffice to soften the steel in its untreated condition.

The whole of the research work, extending over several years, which led to the discovery and development of the magnetic process was carried out with the Herbert Pendulum Hardness Tester. It is doubtful if the discovery could have been made if this instrument had not been available. Each point on every diagram represents the average of 5 to 10 separate tests, each test being made by timing with the stop watch 5 pendulum swings. As the tests were made at short intervals of time, often extended over many days, and were generally applied to quite small specimens, the exacting nature of the investigation will be obvious. The investigation of duralumin and brass, though made originally with the Pendulum, was repeated with the Brinell test. The results were entirely similar, and in Figs. 6 and 7 actual Brinell readings are given.

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Lubricating Open Gears

G. H. Olson
Manager Crane & Shovel Division, Link-Belt Company

OPERATORS of cranes, excavators and other machinery will find the following home-made mixture an especially efficient lubrication for open gears: white lead ½ lb., cylinder oil ½ gal., flake graphite ½ lb. This mixture adheres well to the gears and can be painted on with a brush, as required, at intervals of about five hours The graphite and oil form the lubricating content; the white lead acts as a binder and keeps the gears from cutting. Cup grease may be substituted for the cylinder oil, and the graphite may be omitted, but it is not advisable to do so in warm weather. By increasing the proportion of flake graphite, this mixture may be made heavier for warm weather use. Standard gear compounds may, of course, be used with good results, but they have a tendency to run off the gears when warm.

The Foreman's Round Table

SLOWING DOWN

"GIMME a cigarette, Al, I've got to get some," hailed Ed as he stopped at Al's desk on the way home. "Say, was it you that was telling me about that college professor that put on overalls and hired out in factories and then wrote a book?"

"Do you mean 'Robots or Men'?"

"No, another one, where the author says everybody in the plant is loafing."

"Oh yes, you mean the one about restriction of output. What about it?"

"Well, I got to thinking of what you said about my men slowing down on that stainless steel job, and I remembered what you said that professor claimed to have found, and the two things together made me worry a little. So today I looked into the subject."

"Well, what did you find? Have they been laying down?"

"No, they did drop one hole in the feed table, but the cutting speed is just the same."

"How about the depth of cut, that is where they can fool you because it doesn't show in figures. You have to take a pair of calipers and actually measure it."

"I didn't say anything about the cut. I looked at it and it looked all right. I think that 'Prof' was a hot-air merchant, Al."

"I don't think so. I know and can prove by my records that my own men have slowed down, and I believe that others have."

"What good is the piece work then? How can a man slow down and still make more than his daily rate on piece work?"

"Easy. We have to be very careful in setting prices to set them on the ordinary pace of the worker and then depend upon extra effort to increase output. As a matter of fact, the ordinary pace is getting slower and slower, and the added effort induced by the piece rate barely brings the output up to what it should normally be."

"Why have foremen, then? Why not do away with them?"

"According to the professor the foremen encourage their men in loafing."

"Do you believe that, Al, or are you only spoofing?"

"I only know this, Ed. Industry is being overcrowded with pacifists and philosophers. The only difference between these two is that a pacifist knows definitely what ails him, while a philosopher is trying to justify himself in being a pacifist. One man has a physical reaction, the other mental. A book I read recently said that a foreman must watch the expression on his face, the pitch of his voice and the tempo of his step as he walks down the aisle of his department, lest he disturb the contented state of the workmen. Persistent reduction of the foremen's authority and too much coddling of men have caused the "weak sister" type of foreman to identify himself with the men instead of with management, and a general let-down in morale is the result."

"I don't agree with you, Al. But if it were true, what is the answer?"

"The obvious one is to make the pay match the output, but that answer is not satisfactory."

Has there been a general slackening in output? Is piecework of any value aside from being an artificial boost of day rate? Is the foreman losing his punch, or does he no longer consider it his duty to get out quantity production?

▸ ▸ ▸ Discussion of Former Topics

Share and Share Alike

I do not believe that the incentive feature of management is over done, neither do I believe that an equal dividend would be fair. If equality in dividends prevailed, or incentives were done away with, there would not be any reason for anyone to study and improve themselves in a way that would make them valuable to their country, community and business. Men who can carry responsibility, stand criticism, exercise good judgment and who know their particular businesses thoroughly, become an asset to their company.

The incentive system, in my estimation, is sound. It gives the men who are capable, every opportunity to come to the front by attracting the attention of their superiors through their ability to produce results. Were it not for the incentive system in business, it would be possible for men less capable and less proficient to hide among those who are really producing results.

In my experience I have found the incentive system has been responsible for exposing unfair favoritism which management might never have learned of had there been no incentive system. —A. HALLIWELL, *Superintendent, General Iron Works Company.*

Gilding the Lily

In my opinion, Ed is "all wet." What if some of his workmen had, in the past, purchased a set of mikes and used them where a pair of calipers would have been satisfactory? It is perfectly natural for a man to admire his new tools and to use them at the first opportunity. No doubt there is a little waste of time when this is done, but what of it? In a day or two the new tools are carefully oiled and laid away, and no one is any the worse for the occurrence.

Every skilled mechanic admires good tools and is curious to handle them and get the "feel" of them, more especially when they are new and shiny. This is a perfectly natural, human reaction. Of course we all realize what Ed's feelings are when he sees one of his men using a micrometer when only a rough measurement is required, but in a short time the man will put away the mikes and resume his work in a normal manner.

—CHARLES A. PETERSON, *Master Mechanic, Cold Spring Granite Company.*

Tolerances

Every plant is confronted with the scrapping of material on which there has been expenditure of labor. In these days, when economy is vital, it is important that the subject be reviewed from both the drawing office and the workshop angles. It is better to scrap some old-time ideas than valuable material.

Frequently the tolerances are placed by men who have little or no experience in the shop. To safeguard themselves, they use close limits. I believe the accuracy of essential limits can best be assured by allowing exceptionally large tolerances on non-particular parts. When the machinist sees a tolerance of plus or minus $\frac{1}{8}$ in. on one part, and 0.0005 in. to —0.0000 in. on another, he would pay special attention to the latter, and be able to speed up on that dimension which requires no accuracy.

In the endeavor to reduce the amount of scrap, it is well to review the inspection department. There is no department that is looked upon in such a varied manner as the inspection department. In almost every other department the number of men or supervisors necessary can be readily determined, but no two managers seem to have the same opinion regarding inspection. It is interesting to note the changes that take place in the inspection department in any plant that has a frequent change of managers. A friend of mine made the following note of changes in the inspection department in which he was employed. Manager No. 1 had 12 inspectors, including one on the floor. Manager No. 2 reduced the number to 2, and considered floor inspector unnecessary. Manager No. 3 increased the number to 30 with 10 on the floor. Manager No. 4 reduced the number to 10, all being floor inspectors. Often, the inspection department is looked upon as non-productive, and, therefore, a department that can be cut down to reduce expenditure. Other managers consider it vital to give 100 per cent inspection in order to protect themselves against the inspection of the purchaser.

—SIDNEY BEAUJON.

Something for Nothing

There is no doubt that the opinions in respect to the number of hours per day the rank and file of our shops should work are considerable in number, and each one different. Shorter hours have long been advocated, as has also the curtailing of the production of labor-saving machinery.

There are, on the other hand, experts who swear by labor-saving equipment as a remedy for the present depressing conditions.

Dr. Julius Klein says: "I think that the majority of level-headed students of the machine question will view the machines as a liberator. They see it creating wealth not for the few only. They recognize its prime responsibility for the rise of giant industries."

And again he says: "If our production equipment was replaced by up-to-date machines . . . more business would be engendered and more work would be created." If such is true, it being implied that labor-saving devices relieve unemployment by creating work for more men than machinery displaces, how can we approve of shortening hours?

On the other side of the question, and taking the side of Ed in a way, an eminent official, Mr. Franklyn Hobbs, Director of Research, Chicago, says: "If we go any further in the shortening of hours of work, it will be necessary for an additional number of people to don overalls or the office coat and go to work."

What shall we say then? Shall we do that which we

believe to be coming because we hope somehow that good will result? The reply should be a decided negative because the shortening of hours of work is as much in error as anything can possibly be and the writer has no hesitation in asserting that the engineering trade in England has never been in a good, all-round condition since the weekly hours were changed from 54 to 48. That is the opinion of many over here.

—J. T. TOWLSON, *London, England.*

The Cost of Quality

Precision over non-essentials is absurd, but where quality is essential it cannot be overstressed. In gears, bearings, tools, jigs, patterns, core-boxes, etc., where production and harmonious working are at stake, quality must not be sacrificed.

Show me one workman or foreman who values accuracy at its proper worth, and I will show you a dozen whose motto is to rush work through regardless of defects, leaving inspectors and testers to find the faults. Others desire perfection, but are not willing to allow the necessary time for it. Accurate workmen are considered slow, are victimized financially, and barely hold their job. Workers who rush jobs through regardless of defects are considered smart. Workmen, supervisors, and firms who stake their all on quality, though sometimes sufferers, are the salvation of our industry.

—WILLIAM BRYCE, *Sheffield, England.*

Bad Debts

Some years ago, when I was in charge of a Scottish shop, the laws of the land compelled employers to stop all excess wages over one pound per week on receipt of the Sheriff's decree. This caused endless trouble to the firms concerned, and the services of many good workmen were lost. Immediately the workman was informed of the state of affairs he threw up his job and went elsewhere, covering up his tracks as best he could. Often, useless goods had been practically forced upon the workers' wives and the workers themselves knew nothing of the matter until the decree arrived. The whole affair appeared to be legalized blackmail.

In my present shop, which is free from these laws, any letter regarding overdue accounts addressed to the firm is first shown to the worker concerned, and then promptly returned from whence it came with a polite note informing the sender that we are not debt collectors.

—F. P. TERRY, *Belfast, Ireland.*

On Again, Off Again

During the past several months employers have laid off men when it was to their advantage to do so, which is perfectly all right. An employee should have the same right, and should be permitted to lay off or work elsewhere when it is to his advantage without being barred from re-employment.

A foreman who loses a valued employee would do well to check up on his own actions, as he may be the cause of the man's quitting.

The fact that a man asks for re-employment would indicate that he desired to work with his old foreman, and, past performance being satisfactory, I believe that he should be given the opportunity to do so. There are more men who turn out to be valuable employees after having been re-hired several times than there are who prove to be lemons, and if the foreman will look at all of his experiences along this line I believe he will find this to be so.

—C. F. STAPLES.

Pitiless Publicity

Publicity of errors, if construed in such a manner as to teach employees the cost as well as the cause of such errors, is good constructive criticism, and neither foremen nor workmen have any just cause to be offended. The foreman always comes in for a great deal of criticism no matter what he does, but his shoulders are usually broad enough to carry the burden. He won't object to the publicity of any errors made in his department when assured that such publicity will benefit his company as well as his men.

—W. J. OWENS, *Foreman, Newport Rolling Mill Company.*

Direct Action

Intensified competition has taught that successful operation calls for a clear-cut system of executive control, and the concerns that are top-heavy in this respect are lightening their load and finding the going easier in consequence.

Instead of maintaining a small army of minor executives, whose duties often over-lap and sometimes conflict, the tendency to carry a smaller force of high caliber men is everywhere apparent. This, in turn, makes it imperative that these men be specialists as well as experts in their particular fields, from design to distribution of the finished product.

The logical step, then, is to name these men superintendents of whatever branches they control, reporting directly to a general superintendent, who shall be the final arbiter in any inter-departmental disagreement, or misunderstanding.

This form of direct action, when executive control is concerned, has everything to recommend it and is indeed forming the basis of reconstruction programs in concerns all over the country.

—ROBERT S. ALEXANDER.

"Rules is Rules"

Williams' rule does not in any way cancel any of his former ones, but simply gives the foremen to understand that they were placed in their positions partly because it was thought they could exercise good judgment, regardless of precedent or rules. The answer to the question as to whether such a provision is good management is, in my opinion, that it is not only good management, but good every-day "hoss sense," of the variety that is needed in many business houses overburdened with iron-bound rules. As to its working out, if the management has used any judgment at all in the selection of its foremen and others in executive and semi-executive positions, it cannot help but work out; if not, then it is time for a good "house cleaning."

—CHARLES R. WHITEHOUSE, *Standards Engineer, Holtzer-Cabot Electric Company.*

THE FIRST WELDED TELESCOPE

ELECTRIC WELDING has entered another branch of industry. A telescope tube electrically welded throughout has recently been completed by The Warner & Swasey Company for Perkins Observatory of Ohio Wesleyan University. Heretofore all parts of large telescopes have been made of castings or forgings; their cost, because of the expensive pattern work and heavy machine work, has been an unduly large factor in the cost of the finished instrument.

With the completion of the new tube a new era in telescope construction is introduced. Not only is the total weight of the tube less by approximately 1,500 lb., but the time required for its construction and the cost of material are considerably reduced. The main elements or divisions of the tube are the same as formerly but the materials employed are steel I-beams, angles and plates of standard section and gage.

It is essential that the upper section or skeleton of the tube be detachable; hence this is bolted onto the center section. Otherwise, throughout the structure bolts and rivets are noticeable by their absence. Rigidity, a prime necessity in a telescope, is accomplished by tie-rods. Outer ends of these tie-rods are electrically welded in the corners at the several intersections of longitudinal and transverse members of the skeleton. The conventional turnbuckle in the middle of the tie-rod is employed for tightening.

The largest and heaviest element is the centerpiece, which, as its name implies, is the middle section. This is the section to which the upper element (skeleton) and the lower element (mirror cell) are attached. The centerpiece is bolted rigidly to the declination axis of the telescope. It is this axis which, together with the polar axis, makes it possible to point the telescope tube to any desired section of the heavens.

The centerpiece affords an excellent example of economy of weight and of greatly reduced cost. To withstand the heavy stress imposed by the great mass of glass at the lower end of the telescope tube, the centerpiece is designed with unusually heavy elements. Its internal structure is made up of circular members, separated by longitudinal I-beam spacers. The top circular

The electrically welded telescope for the Perkins Observatory, Ohio Wesleyan University. The 70-in. shutter, largest of its type so far installed, is closed. This telescope was made to provide for the new 69-in. mirror produced by the U. S. Bureau of Standards, the first large telescope mirror made in America

member is composed of plates bent and welded together to form a circular angle. Two such circular angles, welded together, form a circular channel. Below this are three circular members likewise built up of plate and hoops; these are welded to the form of I-beams. The four circular members just described are separated by longitudinal spacers of standard I-beam section, welded in place at equal intervals in the circumference.

Details of the welded six-pointed star support in the mirror cell

The heavy socket which provides for attaching the finished tube to the head of the declination axis was built up of $1\frac{3}{8}$-in. plate of cylindrical shape which intercepts the circular elements previously described, being welded at all intersections. The socket was completed by welding a heavy circular hoop to the outer surface of the plate.

The outer portion of the centerpiece was next installed. This is a plate rolled to form a great cylinder which completely encloses the structural elements described, being welded to them at numerous points. At the lower inside edge of this great cylinder are two circular angles, also welded in place. These angles form the reinforcing for the lower edge and also provide for the attachment of the third element of the tube.

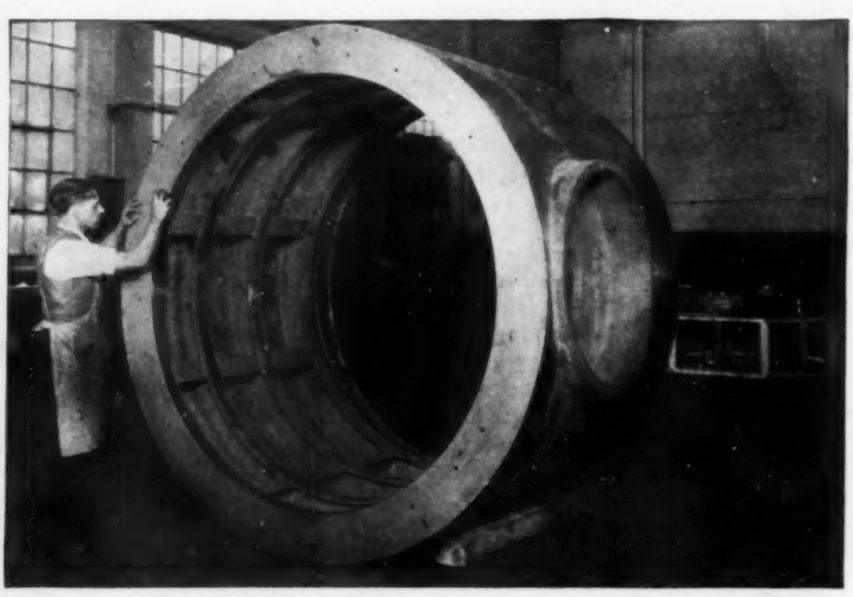
This third or lower member, called the mirror cell, is a great pan in which the 69-in. concave mirror is housed. The vertical side of the pan is a steel plate bent to form a cylinder 16 in. high and welded. Reinforcing at its upper edge is accomplished in the same manner as at the upper edge of the centerpiece, except that the ring is welded to the outside of the pan, thus providing an exterior flange. This flange affords means of bolting the mirror cell to the centerpiece directly above. At the bottom of the pan are I-beams, arranged in the form of a six-pointed star, the points of which are welded to the inside wall of the pan.

Welded to the under side of these I-beams is a flat circular plate for attaching auxiliary apparatus such as spectrographs and photographic apparatus for use when the telescope is employed in its Coudé combination (two reflections with the light passing through the hole in the main mirror). Inside of the pan are three pairs of pads equally spaced and mounted on the I-beams by collimating screws. This design permits supporting as well as collimating of the mirror. Other supports which resemble brake shoes are placed on the inside edge of the pan to prevent the sidewise movement of the mirror during the manipulation of the tube. Both rear supports and edge supports are designed to maintain at all times the optical axis of the mirror with the mechanical axis of the tube. This system of supports for the mirror is essential to prevent sagging of the great mass of glass, which would cause imperfect light reflection. A retaining ring at the upper edge of the mirror prevents accident in case the upper end of the tube is tipped below the horizon.

The observing positions with this telescope are three in number; prime focus position at the upper end of the tube, the Newtonian at the side of the tube near its upper end, and the Cassegrain position beneath the main mirror. At the prime focus the light from the object being observed is reflected from the main mirror to the photographic plate attached to the upper end of the tube. In the Newtonian position an auxiliary flat mirror is employed to transmit the rays at right angles to the optical axis of the main mirror. This observing position is near the upper end of the tube and at the convenience of the observer can be placed at one of three points by rotating the auxiliary mirror. Observation at the Newtonian focus may be either visual or photographic.

The Cassegrain focus involves two reflections, first from the main mirror, then from the Cassegrain convex mirror supported in the same housing at the upper end of the tube, as was the case with the auxiliary flat mirror previously described. Provision is made at the base of the tube for attaching photographic plate holders or spectrographs for studying the spectra of stars. Also observation at this focus may be done visually if desired.

Weight is a most important factor in telescope design because of the requirements of rigidity, rapid movement and the necessity for counter-balancing all movable parts to maintain equilibrium. Because the new tube for the Perkins telescope must provide for a mirror of larger diameter and very much greater weight than that origi-

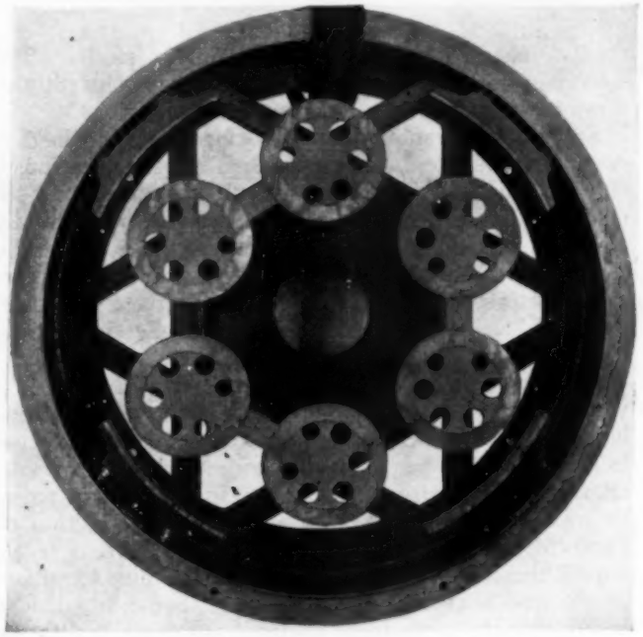


Welded centerpiece, showing the socket for attaching the tube to the head of the declination axis

nally contemplated, it was necessary to find every means of economizing in the weight of the tube.

E. P. Burrell, chief engineer of the Warner & Swasey Company and eminent designer of large telescopes, devised a means for reducing over-all length of the telescope tube which resulted in marked economy in its total weight. Auxiliary mirrors and apparatus for holding them are always incorporated in the upper end of the tube of this type of telescope. The supporting mechanism for this apparatus must be designed to cause a minimum interference to the light of the star or other heavenly body as it passes down the tube to the great mirror at its base. The unique design of this supporting mechanism made possible the economy in tube weight.

The common method of supporting the aluminum cyl-



Bottom supports and edge supports for the mirror in the welded mirror cell

inder which receives the auxiliary mirrors at the upper end of the tube was unchanged in that the usual vertical diaphragm construction is used to lead to four opposite points in the skeleton of the tube. The auxiliary mirror for the Newtonian observing position must provide for the secondary reflection to a focal point at right angles to the optical axis of the main mirror. The usual means of supporting this Newtonian mirror is an adapter inserted in the supporting cylinder, above described, and projecting downward toward the main mirror. In the new tube the design provides for shortening the over-all length of the tube by moving downward the entire cylinder until it surrounds the Newtonian mirror, necessary openings being provided for light transference. This mirror reflects the light rays to the side of the tube in such a manner as not to be interfered with by the diaphragms holding the supporting cylinder.

The advantages of this new design of the upper part of the tube are that it makes possible a shorter tube with less weight and consequently less mass to counterbalance on the opposite side of the polar axis of the telescope. This design also greatly facilitates the attaching and removal of the auxiliary mirrors. These mirrors in their cells can be inserted from the upper end of the tube, for mirror and cell pass through the hole provided in the supporting cylinder. Previous construction has made it necessary to insert these mirrors from below the cylinder, which is not only difficult but increases the hazard to the main mirror at the lower end of the tube. A further advantage is that the adapter at the Newtonian focus is attached to the same framework which supports the Newtonian mirror, thus making for increased rigidity throughout. This design also provides for easier rotation of the Cassegrain mirror when changing observing positions, for this can be done without disconnecting the mirror cell from the supporting cylinder.

The science of astronomy requires the utmost rigidity in the instruments it uses for study of the heavens. While large telescopes of the past have employed every known means to reduce the deflection or sag of the two extreme ends of the telescope tube, nothing approaching the present result has ever been accomplished. Complete elimination of deflection is, of course, an impossibility, for experiments by the Bureau of Standards have revealed that as light an object as a lead pencil causes deflection in a 3-in. bar 30 in. long. Never, however, in the history of precision instruments has such small deflection been possible in the tube of a great telescope. This has been brought about by the advances in welding.

■

Hazards in Fabricating Magnesium Metal

L. E. Averill

MAGNESIUM castings may be considered comparatively free from fire hazards. However, it should be repeated time and time again that chips and dust arising from the machining of these castings present a serious menace. The most infinitesimal spark, such as results from grinding a piece of cast iron on an emery wheel, will cause ignition of small particles of magnesium in the form of a flame which, for all practical purposes, may be considered an explosion.

Where grinding or polishing operations are carried on, a thoroughly adequate system of exhaust hoods and dust collectors must be installed. It is imperative that a water-spray be placed between the wheel and the exhaust duct. The water used in this way may be piped so as to circulate, the flow being effected by a circulating pump attached to the power unit of the exhaust system. It is recommended that each exhaust system be of the unit type, as manifolding presents certain difficulties and fire hazards. Chips, turnings and magnesium dust should be stored with infinite care. This material should be placed in temporary metal containers, and these containers should be removed from the building at the close of the shift. The fire hazard of this material is, in many respects, similar to that of celluloid scrap. Polishing stands and emery wheels operating on magnesium should never be used for any other metal, unless the entire installation has been thoroughly cleaned beforehand. In case of fire, no water should be turned onto the blaze and chemical extinguishers containing water should be avoided. When water is applied, the blaze becomes very intense. Flames should be extinguished by the use of carbon dioxide gas or by the application of sand. In handling the metal, caution should be taken that no salt solution (sodium chloride) comes in touch with it, as the metal is very easily dissolved in that solution.

SOLDERING 18-8 STAINLESS

▼

DISCUSSION

A. EYLES
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Suitable solders, fluxes and methods are here described from a background of practical experience with soldered joints in the "stainless" alloys

DURING the past several years, I have had to do considerable soldering of various modern "stainless" alloys and should like to add a few practical notes on soldering modern stainless steels to the article by Kenneth T. MacGill (*A.M.*—page 386, Vol. 74).

It should be stated at the outset that not only 18-8 stainless "can be soldered easily and well," but all modern stainless steels can be soldered without difficulty when correct methods and materials are employed. Unfortunately, there are too many incorrect soldering methods and poorly designed tools used.

For successful soldering, it is essential to use properly tinned soldering coppers of suitable sizes for applying the necessary heat, or a suitable torch flame. The strength of soldered joints on these alloys is affected by the constitution of the solder, but experience teaches that this is far from being the only factor. The time of contact between the joint members and the molten solder, the soldering temperature, the thickness of the joints, the composition of the flux, and the presence of elevated temperatures are all important in the strength of the soldered joint.

In order to fulfill its proper function on "stainless" alloys, a solder must be hard, tenacious and free flowing in conjunction with a suitable flux. It should also, as far as possible, have the same color and approximately the same strength as the material to be united.

The best soft solders for joining stainless steels are made from pure tin and lead. A good soft solder consists of 66 per cent tin and 34 per cent lead. This alloy has a melting point of 350 deg. F., with a Brinell hardness of 16.7. This solder flows freely, and presents a bright lustrous surface when the soldered joint is buffed.

Ordinary plumbers' solder, containing 66 per cent lead and 34 per cent tin with a melting point of 440 deg. F., is sometimes recommended for soldering "stainless" alloys. Various experiments and tests recently carried out by the writer show that this high-lead solder is totally unsuited for soldering stainless steels. The soldered joints are weak and of a dull-gray color; it also flows and adheres with much more difficulty.

Scrupulous cleaning of the surfaces to be joined is essential to success, as the solders adhere tenaciously only to clean surfaces. This cleanliness should be both mechanical and chemical. The steel may be mechanically cleaned by grinding, filing or scraping, then chemically cleaned by applying a suitable soldering flux. The correct function of the flux is to have a solvent action on the oxide during the soldering operation, thereby keeping the steel surface clean and excluding air.

Zinc chloride has several properties which make it a valuable flux for soldering stainless steels, as it remains liquid at the temperature of molten solder, thus being in a condition to act upon the oxides very readily. An alternative flux can be made in the form of a thin paste, by mixing zinc chloride into a 50 per cent solution of hydrochloric acid. If the consistency of cream is attained, there will be no tendency for the flux to adhere on the steel surface in patches. Care should be taken to insure that the areas to be soldered are covered with the flux. Tin the surfaces first, and then soldering can be done in the normal way. After soldering, the surfaces should be washed thoroughly in a soda solution and then rinsed in clean water to insure that all traces of the flux acid are removed. If any difficulty is experienced in making the solder adhere to polished surfaces, the latter can be dulled by applying the following solution preparatory to soldering: Hydrochloric acid, 45 parts; ferric chloride, 25 parts, nitric acid, 1 part. The solution should be allowed to remain on the steel for about 10 min., then wiped off. Tinning or soldering can then be done in the normal way.

Commenting upon Mr. MacGill's tests on soldered joints "with $\frac{1}{64}$ in. of solder between the surfaces," my experience regarding tests does not confirm his statement, as the strength of soft soldered joints is increased if the film of solder between the tinned surfaces of the joint is kept very thin and the surfaces thoroughly sweated together. The solder penetrates into the pores of the metal thus making a strong soldered joint. True, the strength of soldered joints on "stainless" alloys varies with the composition of the solder and with the method of making the joint. However, the maximum strength obtained in a number of tests by the writer some few years ago on different compositions of solders was 25,000 lb. per sq.in., whereas the tensile strength of modern "stainless" steels range from 80,000 to 95,000 lb. per sq.in.

A. G. BAUMGARTNER
Industrial Engineering Department,
General Electric Company

CUTTING MATERIALS—

Yesterday and Tomorrow

A new factor has been cast into machine tool design by the advent of tungsten carbide. The author hazards several opinions as to the probable influence of this and future cutting mediums

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SUPPORT, close to the tool tip, is also essential to the success of tungsten-carbide tools. Short overhang increases the natural frequency and decreases the deflection of the free end of the tool to such an extent that vibration is negligible and breakage caused by bending is minimized. Tools used in the exterior of cylindrical work should be set with cutting edge on the center or slightly below to obtain free cutting action and to prevent chipping of the cutting edge caused by hogging into the work. The decreased clearance angles of cemented tungsten-carbide tools are another reason for this procedure. The matter of breaking up the chip, as it comes from the tool, is another formidable problem with which the user of cemented tungsten-carbide tools is confronted. Because of its ability to resist abrasion, cemented tungsten carbide will not readily permit the formation of craters such as are found in the tips of high-speed steel tools. The result is a long, stringy chip, which is very objectionable and even dangerous. Numerous schemes have been suggested to remedy this objectionable feature; however, none of them can be considered highly successful. Steel obstructions of various forms, against which the chip should curl and break itself, have been used. Intermittent feed on machine tools has been suggested. Probably as effective a method as any is the grind illustrated in Fig. 5. Instead of grinding the entire top surface of the tool bit according to the cutting angle required, the top side rake extends back only a short distance from the cutting edge. This leaves a portion of the original tip to act as a barrier parallel to the cutting edge. The chip flows down the ground surface, strikes against the shoulder, curls, and breaks into harmless pieces. Grinding difficulties are the chief objection to this scheme.

Since cemented tungsten carbide possesses the ability to withstand wear, it follows that the grinding of the material will not be easy. The material is much harder than normally employed abrasives, and the old grinding methods and equipment were found to be wholly inadequate. New wheels have been developed using silicon carbide with a soft bond. These wheels wear rapidly permitting the removal of the quickly dulled crystals and the ready appearance of fresh sharp ones. However, the present facilities for grinding cemented tungsten carbide leave much to be desired. Even with the new fast-wearing wheels, grinding is relatively slow, and keen edges are difficult to obtain. Using a 60-I grain wheel, a normal tool edge under a strong glass has a jagged and uneven appearance. Light pressures are to be recommended in grinding, while for really keep edges, lapping with diamond dust or boron carbide powder must be resorted to. Lapping cemented tungsten carbide is, of course, tedious and expensive, yet such procedure has frequently resulted in notable increase in tool life over a standard grind.

Cemented tungsten-carbide tools heat up while being ground, and frequently, immersion in water is resorted to as a means of cooling. Such malpractice will inevitably ruin a tool, since the uneven cooling will crack the tips. If cooling is necessary, a portion of the shank only should be immersed. Wet grinding is quite feasible if a tool is thoroughly flooded with the coolant during the process. Dry grinding is preferable to an inadequate

supply of coolant. Moderate grinding pressures must be used.

Because of the grinding difficulties and present high cost of the tools, it follows that cemented tungsten carbide in general is not applicable to machining special work of only one or two pieces, each of which requires a different tool and a different grind. Its best application is in general purpose tools and in tools for high production in automatic machinery where hundreds of similar pieces are produced at a high rate.

Cemented tungsten-carbide tools cannot be applied promiscuously and produce savings. Misapplications cost money, and because of over-enthusiasm, have been of such a frequency as to build up a slight prejudice against the use of this material. A great portion of this resistance is a result of failures, caused by lack of knowledge and superficial tests, made with but little study on the part of the user. Applied in an intelligent manner, cemented tungsten-carbide can produce some amazing results —results which are so numerous that details will be omitted. Double production, tool life per grind increased hundreds of times, the machining of tough alloy steels and highly abrasive and heretofore unmachinable substances indicate some of the wonders this material has performed. And still its potentialities have not been exhausted.

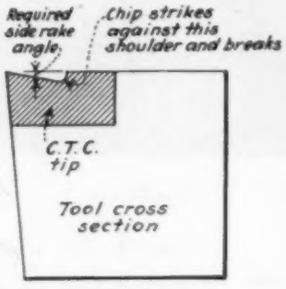
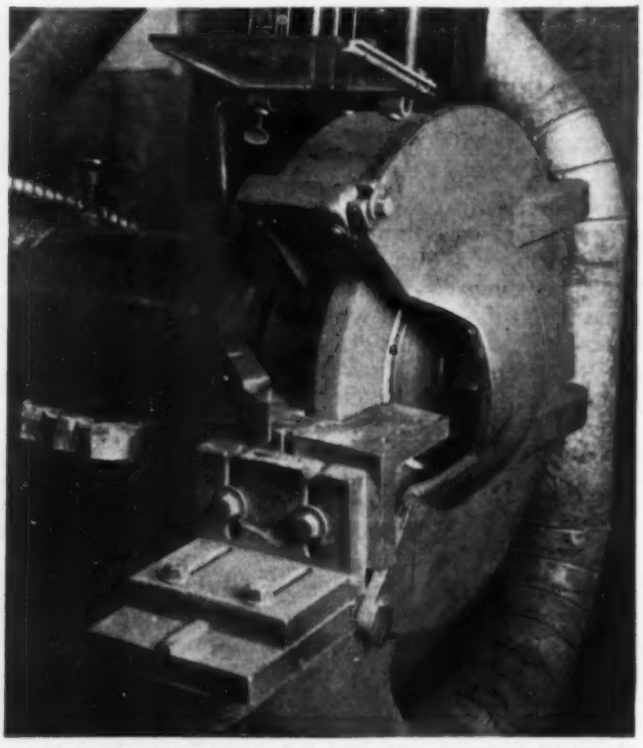
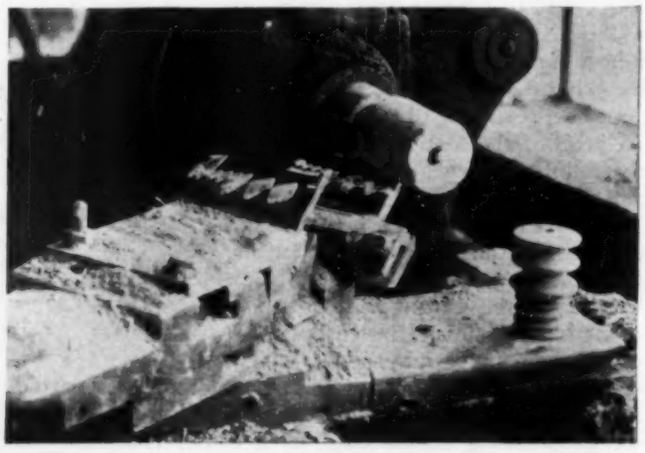


Fig. 5—Chip breaking forms one of the many problems raised by the use of tungsten carbide

Cemented tungsten carbide is especially applicable to non-metallic materials such as fiber, hard rubber, bakelite, unbaked porcelain, molded compounds, carbon products, wood, ivory, asbestos, and glass. These materials are characterized by their highly abrasive action on the cutting tool. Since no great pressures are involved in machining these materials and since cemented tungsten carbide possesses the requisite hardness to withstand wear, the machining of the above substances is an ideal application for cemented tungsten carbide. Another class of materials is that group of low tensile metals, such as aluminum, copper, bronze, brass, and cast iron. Many metals in this class are also highly abrasive. Because of their low tensile strength, tool pressures are low, a combination similar to that of the previous non-metallic group and one which permits cemented tungsten carbide to give remarkable results. The final group includes the high tensile metals, such as carbon steels, roll stock, forgings, nickel steel, non-magnetic steels, stainless steel, and various other alloys. Here tool pressures are high. Because of the weakness and brittleness of cemented tungsten carbide, only proper applications will result in advantageous and successful use of the material. Tools must be rigidly supported with the very minimum of overhang, while vibration in the machine tool, causing minute relative motion between the work and tool, may spell failure for the application. It is not possible to give definite speeds and cuts unless a specific application is under consideration. Some generalities, however, may be made. The following schedule was arranged as a general guide in the application of cemented tungsten-carbide tools. Fig. 6 illustrates the angles referred to.



New grinding wheels and methods are needed to overcome the high resistance to abrasion of these tools



Non-metallic material, such as these green porcelain insulators, may be worked to advantage by tungsten carbide

Bronze—Brass—Copper—Aluminum—Bakelite

Top side rake same as with high-speed steel tools
Clearance angles same as with high-speed steel tools
Depth cut same as with high-speed steel tools
Peripheral speed 150 per cent faster than with high-speed steel tools
Feed per revolution same as with high-speed steel tools

Soft and Medium Cast Iron up to 180 Brinell Hardness

Top side rake 16 to 18 deg.
No back rake
Side and front clearance 6 deg.
Depth cut same as with high-speed steel tools
Peripheral speed 150 per cent faster than with high-speed steel tools
Feed per revolution same as with high-speed steel tools

For certain steel jobs, older cutting materials have given way. A tungsten-carbide tool is shown machining silicon steel punchings in an induction motor rotor

For cast iron over 180 Brinell Hardness

Top side rake 14 deg.
No back rake
Side and Front clearance 4 deg.
Depth cut same as with high-speed steel tools
Peripheral speed 100 per cent faster than with high-speed tools
Feed 25 per cent less than with high-speed tools.

If hard scale is encountered on cast iron, the speed should be reduced and the feed increased to the same as with high-speed steel tools until the tool gets started—then increase the speed as recommended above.

Machine Steel—Cold Rolled Steel—Shafting Steel

Top side rake 16 deg.
No back rake
Clearance 4 deg.
Depth cut same as with high-speed steel tools
Peripheral speed 150 per cent faster than with high-speed steel tools
Feed 25 per cent less than with high-speed steel tools.

High Carbon Tool Steel—Nickel Steel —Nickel Chrome Steel

Top side rake 14 deg.
No back rake
Clearance 3 deg.
Depth cut same as with high-speed steel tools
Peripheral speed 100 per cent faster than with high-speed steel tools
Feed 25 per cent less than with high-speed steel tools.

The foregoing has emphasized the application of cemented tungsten carbide as a cutting instrument in a machine tool. Its use, however, is by no means limited to this field. The material has given remarkable account of itself in dies, saws, broaches, milling cutters, and drills. Cemented tungsten-carbide tipped gages have in one instance reduced gage expense from a gage per day per operator to a negligible item.

One of the most formidable factors, in the application of cemented tungsten carbide, is the attitude of the operator who is to use the tools. Too frequently this attitude is antagonistic, the operator's efforts being dominated by the intent of proving the new material no better than the old steels. In addition, the lack of progressiveness and ability usually found in machinists is keenly felt because cemented tungsten carbide is but one of the many factors in our increasingly complicated industrial system which requires greater skill for satisfactory application. Generally speaking, a good machinist will usually employ cemented tungsten carbide to a distinct advantage where applicable.

A few remarks on future developments in machine tools are no doubt in place although they can be of only a general nature. With the introduction of high-speed steel, the capacity of cutting tools suddenly exceeded the capacity of the machines in which they were used. The first efforts of the machine tool builders were characterized by a lack of initiative to correct this condition. It was only very gradually and after a considerable period of time that machine tools were considered adequate for the requirements of high-speed steel. With the introduction of cemented tungsten carbide, a very comparable situation exists to that of a score of years ago. The attitude of the machine tool builders, however, is considerably improved. Although an appreciable sluggishness still exists, it probably is a legitimate hesitancy prompted by the present vagueness on the potentialities of cemented tungsten carbide or future materials of a similar nature, rather than by an extremely conservative attitude.

The foremost factor to be incorporated in the design of machine tools for cemented tungsten carbide is with-

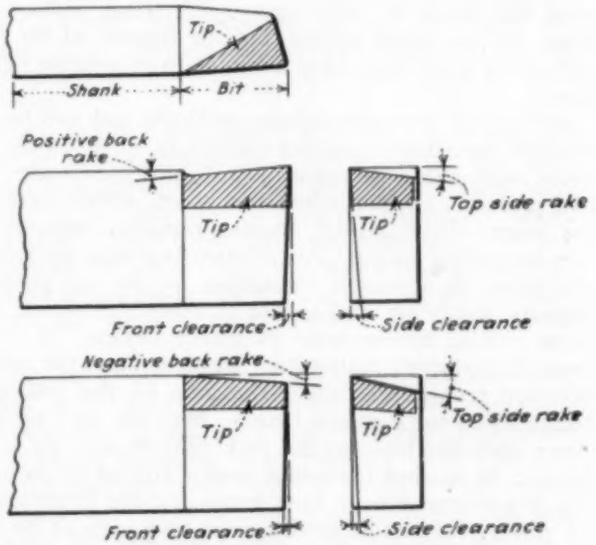
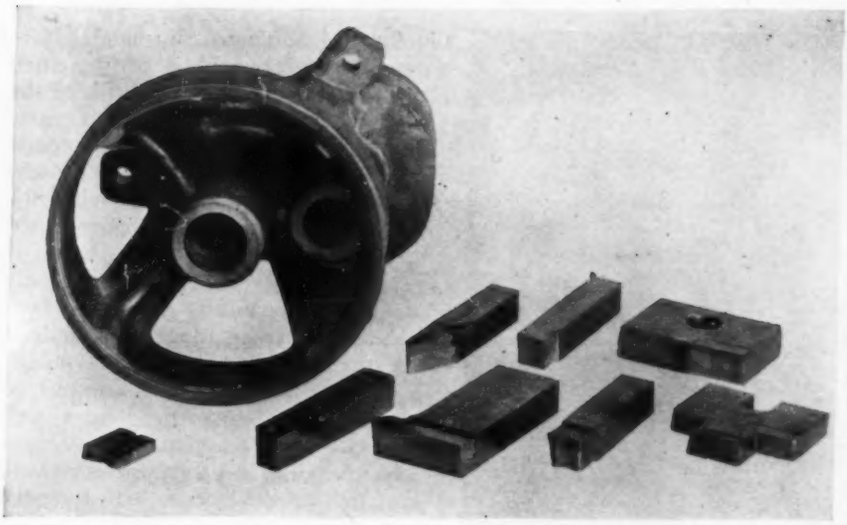


Fig. 6—Correct rake angles depend upon the substance to be cut. For values, see the accompanying tables



Despite an antipathy toward so radical a departure from former practice, shop men are recognizing the merits of tungsten carbide when properly applied

out a doubt rigidity, or to put negatively, lack of vibration. Cemented tungsten carbide has no temper. It will readily operate at red heat, assuming the braze equal to the task. Cemented tungsten carbide does not "burn up" like high-speed steel. Practically every failure of cemented tungsten carbide is caused by chipping or crumbling of the tool edge. Cemented tungsten-carbide tool failures frequently have the appearance of high-speed steel failures, but this is not caused by burning of the material. This appearance is a result of some of the stock being caught on the rough edges and smeared into the fracture, and because of the high temperatures involved, becoming oxidized. Removal of the stock will frequently disclose a clean fracture of the carbide underneath, or at least, only an abraded surface.

Tool life, therefore, is limited by failure of the tools caused by chipping and by dulling from abrasion. Since cemented tungsten carbide resists abrasion, our chief problem centers on a means to avoid chipping or fracture of the cutting edge. Rigidity of the work and of the tool is the best insurance against such results. Not only must the braze be satisfactory, the shank sufficiently large, and the grind correct, but the support of the tool and of the work must have a minimum of relative vibration.

Because of its wear-resisting qualities and low tensile strength, cemented tungsten carbide is at an advantage when used with a decrease in feed, which decreases the tool pressure, and an increase in speed, which increases the wear. With higher speeds, vibration becomes an ever-increasing factor. Antifriction bearings, preferably preloaded to eliminate clearances as far as possible, dynamic balancing, and a host of other mechanical features will be incorporated in future design. It seems desirable to have a cutting tool set on end and the cutting pressure transmitted along the axis of the tool as a compressive force rather than to have the tool act as a beam with the load on the end. Power and its transmission is another important item. Helical gears are a big improvement over spur gears for the transmission of power. Motor capacities must be increased both as to speed range and as to horsepower. A standard d.c. motor will give a speed range of about 4:1, any intermediate speed being available. Ordinary a.c. motors are limited to four different and fixed speeds, without having the bulk of the motor become unduly large. With the system known as the "Ward-Leonard control," a 10:1 speed range and larger can readily be obtained; however, the expense and characteristics of the equipment involved are not altogether what might be desired. A recently developed combination of two d.c. motors permits a speed range of 12 or 16:1, the constant horsepower output being equal to that of one motor.

That motor horsepower must be increased is very evident. For all practical purposes, holding any two of the three factors, cut feed, and speed, constant, the horsepower increases and decreases proportionately with the third. A specific example of some of the increased power requirements may be of interest. A new boring mill was used to machine an iron casting. With one tool working, the motor could have been loaded to 300 per cent of its capacity. With two of the three heads of the mill in use, a load of 600 per cent would have been quite feasible. The standard motor was replaced with a motor three times its capacity, and tests were made on a steel casting. Four times normal hp. were actually used to load but one tool up to its capacity. Since the machine was not designed for this service, the experiment was brought to a conclusion by a failure of the transmission.

Machine tool builders will be criticised to some extent because of the inevitable lag in their designs, yet they are quite justified in being somewhat backward; in fact, they cannot be expected to keep abreast with a development which they cannot predict. With the present degree of specialization, generalities are dangerous, and specifications meeting one application will probably be entirely out of place in another. Each problem has its own details, different from another problem, and probably just as essential. In addition to the indefinite limitation of cemented tungsten carbide is the increasingly evident fact that cemented tungsten carbide is not the only material available and should by no means be considered the limit. Although still in the development stage, there are at present in shop use tools, tipped with a material possessing all the desirable attributes of cemented tungsten carbide with the important additional virtues that it can be ground as easily as high-speed steel and that the desirable keen edge is readily obtained. With developments following each other in this rapid manner, the correct attitude is one of alertness and open-mindedness.

■

PIERRE F. M. AUBERT of Aubert & Duval Freres, Paris, now visiting the United States, has brought with him a Citroen crankshaft assembly made up of a nitrided crankshaft and piston ring and a duralumin piston and connecting rod. No babbitt is used in the bearing between crankshaft and connecting rod, the aluminum bearing directly on the nitrided steel. Nitriding produces a dense surface structure that resists loading of the shaft by the softer metal and consequent seizing in the bearing.

HUMAN NATURE IN THE SHOP

FRANK L. EIDMANN

"Every executive in giving a general order which in any way involves the human element must take into consideration the probable reaction on every employee . . . if the loyalty and morale of the organization is to be maintained to the highest degree"

IT is not necessary to take a course in psychology to learn how the average person will react to a given set of circumstances. Observation of individuals in all walks of life will reveal interesting facts which may be of great value in predicting the reactions of other individuals or of groups under somewhat similar conditions.

Every executive in giving a general order which in any way involves the human element must take into consideration the probable reaction on every employee. Probably the simplest and most successful rule to be used in attempting such a prediction is for the executive to attempt to imagine himself in the place of the worker. But this is not as simple as it sounds, for not all employers have worked in the ranks and are in position to know all of the angles from which the worker will view the new edict.

New personnel problems arise daily in industry, and the employer who handles them thoughtfully and individually is usually well repaid for his efforts. Often the employment of a very simple experiment, which might be termed an application of psychology, is more effective than drastic rules or threats of penalties. For instance, some of the best workers in a machine shop were in the habit of ringing in late almost every morning. Warnings by the superintendent were ineffective, for skilled workers were scarce at that time, and these men felt rather independent. The matter was reported to the factory manager who thereupon went to the time clocks personally to look over the time cards. He simply drew a red circle about each late record on the time cards of the offenders. He had a clerk follow this procedure for about three days, and all lateness, without exception, stopped. Just put yourself in the worker's place. How would you feel upon finding your lateness conspicuously marked if you had been given no indication as to who in the front office was so carefully checking your attendance and with what intention?

In many plants important notices are posted on the time clock of each department, where everyone is sure to see them. I wonder how many plant managers realize the cost of this, if the clocks are located within view of the work-places. As soon as the notice is posted, the employees begin leaving their work and go to the clock to read the notice—until every man in the department has read it. Needless to say considerable time is also lost in discussions of the notice. Some employers have adopted the obviously more satisfactory plan of posting the notices on bulletin boards which are not visible from the working places but which are located where they are seen by all as they leave the plant, near the exits.

It is common experience to have applicants come to the employment office in pairs. Experience shows that if these men are hired, and one becomes dissatisfied and quits, his friend usually quits also. It is well for the employer to take this into account when hiring.

Unfortunately, not all well-intentioned experiments involving personnel attain the results anticipated. Several unsuccessful experiences of this kind will be related.

The engineering and sales departments of the plant naturally receive many magazines and technical journals. Somebody in a certain plant suggested that it was a shame to burn all these magazines. Why not let the men in the shop take them home. So the manager of industrial relations had a shelf erected just outside his office and here the magazines were placed. They disappeared very quickly, some men taking several. A few of the publications were taken home, but most of them remained in the plant where they were in all too many instances read by men at their machines. The machines were in operation, it is true, but the sight did not meet with the approval of the foremen and the superintendent, and the plan although modified several times had eventually to be abandoned.

A New England plant had completed a large and important order in less than the scheduled time. The management was rightfully pleased, so a nicely worded note was posted in which the shop employees were complimented and thanked for their co-operation. Not two days passed before a committee representing the shop employees appeared before the manager in the interests of a general wage increase directly as a result of the notice.

During the War some plants, instead of increasing the basic wage rates, gave a so-called "War Bonus" to compensate for the increased cost of living. This bonus was put in a different envelope from the regular pay, the idea being that after the War the bonus would be discontinued and the worker would again receive his pre-war wage without the feeling that his pay had been reduced. This may have sounded very well in theory but did not work out at all, for though in a separate

envelope, the bonus was considered by the worker to be part of his earnings and any reduction caused trouble.

In most plants there are usually a few jobs for unskilled labor which are not desirable as permanent work, and a new man is placed on that job with the promise that he will not be kept on it longer than two weeks and that he will be transferred to other work. In a certain plant long spindles of small diameter had to undergo a straightening operation after being heat-treated. It was a slow, tedious operation and many men would quit before the first day was over. One newly employed man who was beyond middle age was put on this job with the promise of early transfer. He made no complaints about the work, and when an opening appeared elsewhere in the shop the employment manager asked him whether he would be interested in it. Much to the surprise of everybody concerned the man asked to be left on the straightening job. He liked it and stayed on that work for a long time. Incidentally he did the work in a very satisfactory manner and turned out more work than any of his predecessors.

Opportunity for promotion is usually considered one of primary importance among the requisites of a position, yet the writer has had a number of cases in the shop and in the office where a man selected for promotion has preferred to remain on his old job and to see younger men promoted over him. Some persons are afraid to accept responsibility even at considerable increase in salary.

Every executive has had countless similar experiences of occasional employees reacting in a manner quite contrary to the average when opportunities or other conditions are presented—which simply goes to show that human nature, whether in the shop or elsewhere, cannot be handled according to any fixed formulas. Each employee must be considered individually if the loyalty and morale of the organization is to be maintained to the highest degree.

NEW BOOKS

PATENT LAW FOR CHEMISTS, ENGINEERS AND EXECUTIVES—*By Fred H. Rhodes, Professor of Industrial Chemistry, Cornell University, 207 pages 5½x8 in. Indexed and Appendixed. Clothboard covers. Published by the McGraw-Hill Book Company, 370 Seventh Avenue, New York, N. Y. Price $2.50.*

Despite present-day wide appreciation of the importance of applied science in industry, there exists among executives and investigators a surprising lack of information concerning that division of the law which has to do with protection of the results of research. The law of patents is usually considered so intricate and mysterious that it must forever remain beyond the ken of all but those with professional training in this field. This lack of familiarity with even the fundamental principles of patent law has often resulted in needless confusion and financial loss. This book was written primarily for chemists, engineers, business men and others to whom the subject is important because of its relationship to their business and professional activities. Much attention has been paid to the nature and scope of patents and the extent of the protection afforded by them. Comparatively little space is given to the consideration of the formal matters of procedure to be followed in obtaining patents, since this is almost always handled by patent attorneys.

Tiresome legal phraseology and lengthy, involved explanations are avoided, and the author has shown particular ability in selecting cases for examples. The book is simple and easy to read and provides a ready reference work for the practical man.

HANDBOOK OF OIL BURNING—*By Harry F. Tapp, A.S.M.E. 629 pages, 4½x7⅛ in. Flexible clothboard covers. 123 tables and 358 illustrations. Indexed. Published by the American Oil Burner Association, 342 Madison Ave., New York, N. Y. Price $3.00.*

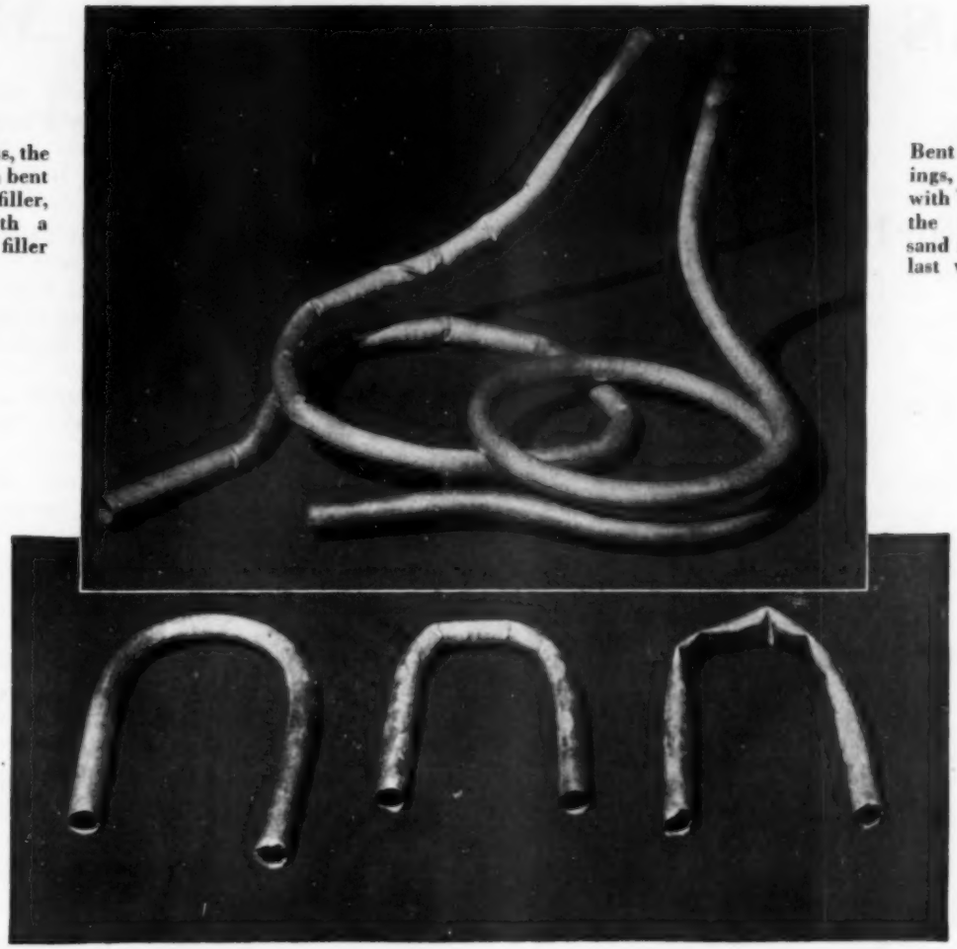
Oil burning has attained great prominence during the past several years, resulting in the need for an authoritative, practical handbook on every phase of the subject. Information of unusual practical value to the machinist and mechanical engineer whose work requires a knowledge of oil burning is included in this comprehensive volume. In addition to authoritative information, charts, tables, and descriptive illustrations relating to every phase of the oil burner industry, the handbook discusses in detail oil burner types and principles of construction, controls, motors and industrial and domestic oil burner applications. Information on the chemistry of combustion and flame, fundamentals of heat and heat transfer, determination of heating capacity requirements, and comparative fuel costs also is included. The final chapters give essential information on sales and service, tests and test codes, accounting and business law, and necessary miscellaneous information and tables.

MECHANICAL LABORATORY METHODS (FOURTH EDITION)—*By Julian C. Smallwood, M. E., and Frederic W. Keator, M. E., associate professors of mechanical engineering, Johns Hopkins University and Sheffield Scientific School, Yale University. 386 pages, 6x9 in. Tables and 122 illustrations. Indexed and appendixed. Clothboard covers. Published by the D. Van Nostrand Company, Inc., 250 Fourth Ave., New York, N. Y. Price $3.50.*

This standard text, in its new edition, retains the features that won recognition for earlier editions, but has been improved by the addition of new methods and more precise instruments developed during the last several years. It is primarily a textbook and has been specifically written for student use, yet it contains much material that should be of value to the practical engineer, particularly to the man whose education and textbooks on this subject date back over a period of several years.

The volume is written to permit its adaptation for use in laboratories with widely differing equipment and procedure. It does not overburden the reader with details, it omits discussions of thermodynamics and mechanics readily found in other works, yet it covers fundamental principles with sufficient thoroughness and clarity to enable the reader to apply them to specific cases.

[Right]
Bends in brass, the kinked section bent with a sand filler, the other with a Wood's metal filler



[Below]
Bent copper tubings, the first filled with Wood's metal, the second with sand as a filler, the last with no filler

Bending Thin-Walled Tubing

WALTER C. SMITH
Metallurgist, Cerro de Pasco Copper Corporation

MANY uses have been developed for thin-walled tubing of brass, copper, tluminum and other metals. One difficulty experienced in these applications, however, has been that of forming and bending it to the desired shape. It is customary to fill the tubing with a suitable filler, bend or form it, then remove the filler. Tar, pitch and rosin have been used; they produce satisfactory bends, but the use of any of these organic materials introduces a new problem, that of removing the filler completely. The major portion can be removed by heating and draining, but a thin film will usually adhere to the tube interior, sometimes with detrimental results. Organic solvents may be used to remove this film, but this of course introduces another operation and increased expense.

Filling the tubing with tamped fine sand produces satisfactory bends in heavier-walled tubing, but does not give good results on thin-walled sections because of the tendency of the tube to crimp on the inside of the bend. The writer has found Wood's metal, an alloy of bismuth, lead, tin and cadmium, having a melting point of approximately 160 deg. F., to be satisfactory for this purpose. It is meltable in boiling water or steam, and is readily obtainable in 10-lb. ingots.

The tube is closed at one end by means of a cork or plug, then warmed with a blowtorch flame or boiling water or steam, and the alloy poured in. (Boiling water may be poured in with the alloy, since it will be displaced anyway by the metal.) The alloy is allowed to cool and solidify; cooling may be expedited by means of cold water. The tube is then bent or formed as desired and the alloy removed by reheating. Care must be taken not to overheat the tube, or the Wood's metal may tin the inside.

The alloy may be used repeatedly, unless it is overheated, in which case dross forms, and selective oxidation changes the composition of the metal to make it an alloy with a higher melting point.

IDEAS FROM PRACTICAL MEN

■

A Fixture for Holding Thin Work

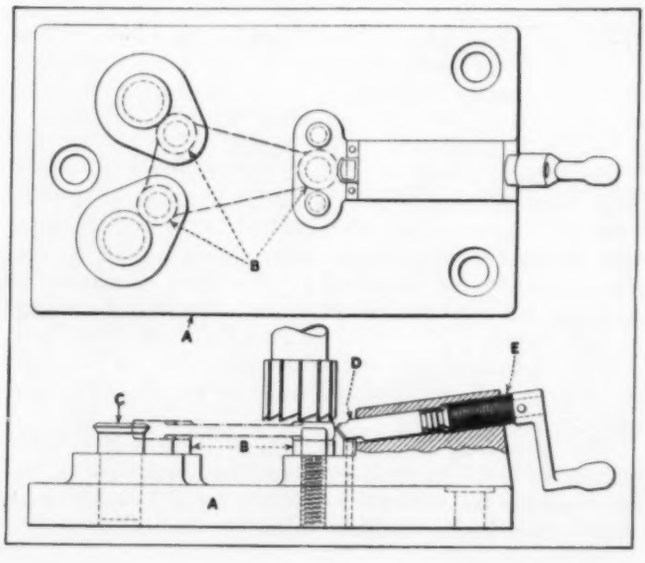
R. J. Williams

A FIXTURE for holding thin work should be designed so that the top and sides of the work can be finished at one setting, and so the work will be held down firmly and be uniform in thickness. Also, it should be both simple and easy to operate. The illustration shows a design of fixture that meets all these requirements, and is satisfactory on both large and small work.

The base *A* is a gray-iron casting on which are bosses for attaching the rest stops *B* and the knife-edge stops *C*. The design of the base is such that the fixture can be used on the planer, the shaper, or the milling machine. The angular clamping surfaces of the knife-edge stops and the clamping plunger *D* are approximately 45 and 60 deg. from the horizontal above and below the edges, respectively. When clamping the work, sufficient pressure is applied to the plunger by means of the screw *E* to force the edges of the stops and the plunger to indent the edges of the work 1/16 in. or more.

Because the angles of the knife-edges are greater below than above, more resistance is offered by the lower angle when entering the work, causing a downward pressure of the work upon the rest stops. To further insure the work being held down firmly on the rest stop nearest the clamping plunger, the plunger is so positioned that it approaches the work at a downward slant of approximately 8 deg. from the horizontal. So that the clamping plunger can be moved axially without revolving, it is connected to the screw by clips, and a block is placed under the flat behind the knife-edge.

The design of the fixture can be modified to hold parts of almost any shape or size. For large parts, two or more clamping plungers and a sufficient number of knife-edge stops should be used. All parts except the base may be made in quantities and kept in stock, since their design is the same for all applications.



Efficient and Easily-Made Press Tools
Discussion

Wm. Butzlaff

While the press tools described by Charles H. Willey in an article under the title given above (*AM*—Vol. 74, page 769) are easily made, I think they are far from being efficient. Any press tools that cannot be used at a stroke faster than 33 per minute are certainly out of date.

Most shops now make their press tools of high-carbon, high-chromium steel, and use them in as short-stroke, high-speed presses as the jobs will permit. If such tools are used in connection with feed rolls, work similar to that described by Mr. Willey can be produced at the rate of from 12,000 to 15,000 pieces per hour, or from six to seven times his production.

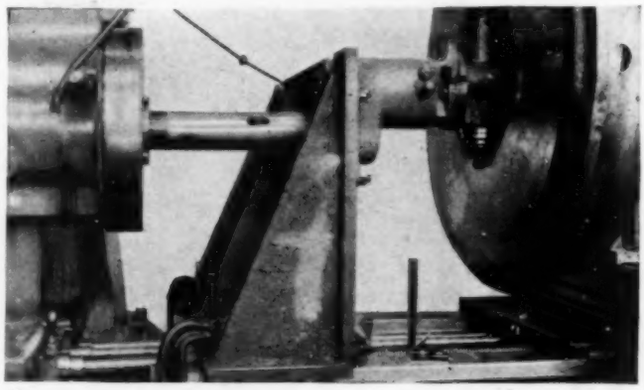
■

Milling Pockets in Large Work

Merton W. Seavey

Foreman, Doheny-Stone Drill Company

In the manufacture of what we call our rotary table, it is necessary to machine four pockets into which driving lugs fit. The large size of the table, and particularly its shape, make the job rather a difficult one to handle.



The diameter of the table is 5 ft., and the pockets to be machined are 5 in. wide, 1¼ in. deep and 5½ in. long. The pockets are cored in the casting and about ½ in. is left for machining, because they must be accurately located.

When the table comes from the lay-out department, it is mounted in a large V-block on the table of a horizontal boring mill, as can be seen in the illustration. An angle plate is mounted directly on the ways of the machine. Holes drilled in the angle plate permit the mounting thereon of a universal milling attachment belonging to one of our milling machines. An arbor to carry the driving gear for the universal attachment is the only special equipment required. Because of mounting the table in a V-block, once the cutter is properly set for the first pocket, no vertical movement of the cutter is necessary for milling the other pockets. The holes in the angle plate are large enough to permit the

universal attachment to be shifted for any change in setting caused by the difference in length of the end mills used.

In operation, the universal attachment remains stationary, all movements necessary to mill both the sides and the ends of the pockets are made by the machine table. The size of the rotary table and the diameter of its central hole can be judged by the 12-in. scale on the ways of the machine. The universal attachment just fits nicely in the central hole in the work. This set-up shows how what may appear to be a difficult job of machining can sometimes be done by using standard equipment belonging to various machines in the plant. By this means, expensive special tools and fixtures are not necessary, especially where the production is limited to a few pieces per month.

■

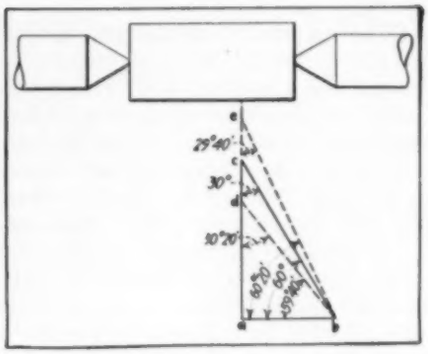
Cutting Multiple Threads—*Discussion*

EDITOR'S NOTE: Probably the chief value of this department is the opportunity it affords for the exchange of ideas among readers. The extent to which these columns are so used becomes evident when the discussions of some of the topics are traced back. On a number of occasions, the discussions on a given subject have been collected in the form of a symposium. But more often they appear serially, one comment provoking another.

A case in point is the article by Harvey Chandler (AM—Vol. 73, page 172) on a method of cutting multiple threads using the compound rest. John Pearman saw an objection in this for coarse pitches (AM—Vol. 74, page 23), and outlined two alternate means. Then Francis W. Shaw (Vol. 74, page 591) offered a modification of Chandler's original scheme which overcame its objections. Charles Kugler (Vol. 74, page 658) and P. Shackelton (Vol. 74, page 837) both commented further on Pearman's suggestion. Now we have another discussion of Shaw's proposal.

WILLIAM S. ROWELL

Thanking Francis W. Shaw for his contribution, the writer would like to add that the possibilities of varying the longitudinal travel of tool by oblique setting of the compound are not always realized. Stating the truth that compound screws are rarely dependably accurate, Mr. Shaw says, "Errors of excess, but *not* of shortage, (the italics are mine) can be compensated for by inclining the compound rest to the work axis." By shifting the compound to 30 deg. off normal, compensations are as readily made for shortage as for excess. Taking the same example, namely a quadruple thread of 6¾-in. lead to be cut with a ½-in. leadscrew, proper spacing can readily be obtained as clearly described by Mr. Shaw. If, as is often the case, the compound screw is not sufficiently accurate, compensation may readily be made. Suppose the screw has a minus variant of 0.010 in. per inch. Set the compound 30 deg. off normal as diagrammatically shown in Fig. 1. Thirty degrees is used because the sine of 30 deg. is ½. An accurate screw producing 2 in. of movement along the line *bc* of the 90–30–60 deg. triangle *abc*, would at the same time produce a longitudinal movement *ab*, of 1 in., but as the movement produced is 0.010 in. short in each nominal inch of movement, some other angle must be used to provide the necessary compensation. The line of movement is the secant of angle *b* which is 60 deg. with a modification made necessary by the error in the screw.



Referring to a table of natural trigonometrical functions, it is seen that secant 59 deg., 40 min. is 1.9801. This gives the desired 0.020-in. correction within 0.0001 in. Therefore the compound should be shifted to 30 deg. 20 min. producing angle 59 deg. 40 min. at *b*. The movement would then be along line *bd*, which is enough shorter than *bc*, to provide the needed compensation. Conversely, compensation for an error of 0.010 in. per inch excess, would be made by increasing angle *b* to 60 deg. 20 min., which is correct within 0.0004 in. If greater accuracy is desired, one can interpolate to obtain the fractions of minutes; but as compounds are graduated in degrees only, minute settings are necessarily guesses. With an accurate screw, and the compound at 30 deg. or with a defective screw properly compensated, all required longitudinal adjustments of tool are made by moving the compound twice as far as the required longitudinal adjustment.

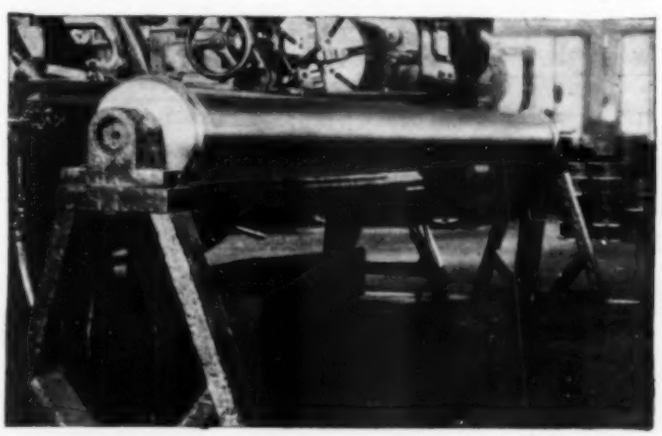
■

Preserving Original Lengths of Locomotive Rods

S. W. HOWELL

In working on rods and laying out locomotive shoes and wedges, the correct original lengths of the rods must frequently be referred to. Since it is impossible to set trammel points accurately from a steel tape, it has always been necessary to preserve the rod lengths by pick-punch marks the proper distance apart on some convenient metal surface. In small shops, the correct lengths are sometimes scribed and prick punched on the side of a planer table. Such an arrangement is, of course, unsatisfactory, for the planer must be stopped to see the marks.

Square or round metal bars, finished all over and carefully kept in a wooden case at the rod bench, are also



used to mark the original rod lengths on. While this practice is considered satisfactory, it is rather inconvenient for the shoe and wedge men, who use these marks as often as the rod men, and who must go to the rod bench to set their trammel points. Also, since there are a great many different lengths of rods used on most roads, it is inconvenient to find the length of the one required, especially if many gages must be looked over.

To provide a convenient and accessible place for preserving the original lengths of rods, the steel cylinder mounted on trunnions, as shown in the illustration, has been adopted by a large shop in the west. It is homemade, the cylinder being a piece of 6-in. pipe turned and polished and having parallel lines 1 in. apart drawn lengthwise by the lathe tool. A line is also scribed around the cylinder at one end to serve as a base line. The original lengths of rods are laid off on the parallel lines, using the base line as a point of departure. Prick-punch marks on the lines serve for setting the trammel points. The trunnions are welded to the pipe caps, and the bearings are those for reverse shafts. The device is placed half-way between the erecting floor and the rod bench, where it will be convenient for both gangs.

■

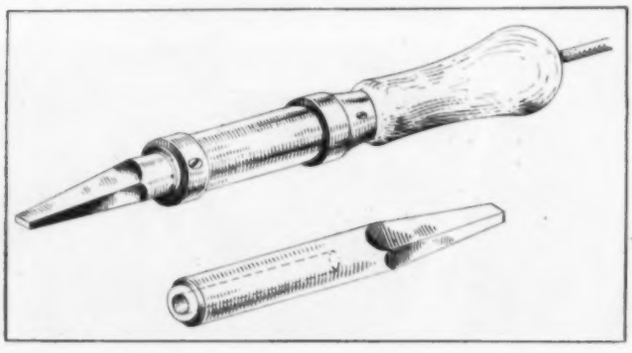
Care of Electric Soldering Irons

CHARLES H. WILLEY
Superintendent of Manufacturing, Hoyt Electrical Instrument Works

We have had several costly experiences in the ruining of our electric soldering tools, because the users carelessly failed to remove the copper tips often enough. When soldering tools are in continuous use, if the tips are not removed as often as once a day, the shanks becomes corroded, or scaled, as to be non-conductive. When in this condition, they are frozen in the shells so tightly that attempts to remove them nearly always results in ruining the heating elements.

We have succeeded in saving many of our soldering tools when the users have neglected to take proper care of them. A hole is drilled lengthwise in the shank of the copper, as shown in the sketch. While this hole does not affect the heating of the copper enough to impair the use of the tool, it helps in removing a frozen copper without injury to the heating element. Nearly always we can twist it out by holding it in the vise and twisting the handle in alternate directions.

Should we fail to remove the copper by this means, we saw it off close to the shell. The hole previously drilled in the shank can easily be enlarged to leave a thin wall that can be collapsed, so that what remains of the shank can be drawn out of the shell. Thus no damage is done to the heating element.



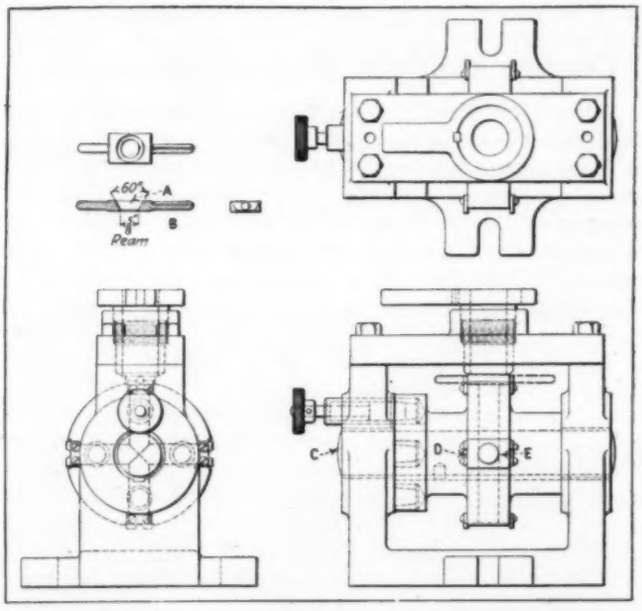
Attempts to drill out a solid shank have nearly always resulted in either breaking the drill or running it into the shell and ruining the heating element.

■

Jig for an Expansion Valve Driver

CHARLES C. TOMNEY
Chief Tool Designer, Brunswick-Kroeschell Company

Formerly we used a small box jig for drilling, reaming, and countersinking the hole *A* in our expansion-valve drivers, one of which is shown at *B* in the illustration. On account of the lightness of the piece and the comparative largeness of the countersunk hole, both the jig and the work heated up rapidly, so that it was necessary to have a pail of water beside the drill press to dip them into to cool them.



To overcome this trouble, we designed the jig illustrated herewith. It consists of a base; a cap; an indexing work holder having four stations and revolving on the shaft *C*; a threaded bushing to clamp the work and to receive the necessary slip bushings; and a spring-actuated index pin. The work holder is flanged at the left to accommodate the four bushings for the index pin.

The work, shown in heavy dotted lines, is located endwise by the steel pieces *D* and is clamped by the threaded bushing at the top. A lever attached to the head of the threaded bushing serves as a wrench. First, a $\frac{13}{64}$-in. hole is drilled in the work, using a slip bushing inside the threaded bushing. Another slip bushing is used to guide the countersink, but no bushing is used to guide the reamer, it being allowed to follow the hole. The depth of countersinking is controlled by a stop collar on the tool contacting with the top of the threaded bushings.

After the first piece has been machined, the threaded bushing is unscrewed and a second piece is inserted in the work holder at station *E*. The work holder is then indexed one-quarter turn, bringing the piece under the

threaded bushing, by which it is then clamped. Simply touching the finished piece with the finger causes it to drop out of the work holder. With this jig, it is not necessary to cool either it or the work, nor to clean the chips from the machine table after each piece has been machined.

■

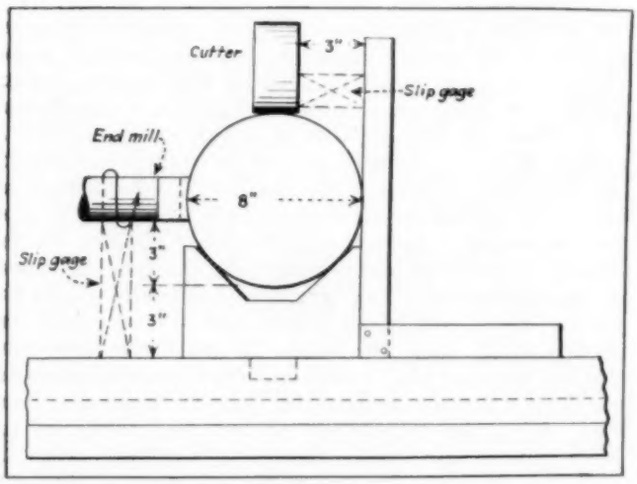
Cutting Keyways at 90 Deg. Apart

J. T. Towlson
London, England

In cutting keyways 90 deg. apart and at opposite ends of the work, as in the driving axles of locomotives, machines devised for the purpose are not to be found outside of plants building locomotives. However, such work has to be done in locomotive repair shops, and with as much accuracy as if the special machine were available.

While there have been many means for supplying a substitute for the quartering machine, as it is called in England, an ordinary milling machine having an adequate length of table can be used. The axle to be keywayed is clamped in tenoned V-blocks on the table of a machine having a table travel that is adequate for milling both ends of the work at one setting.

For cutting the first keyway, a cutter of the proper



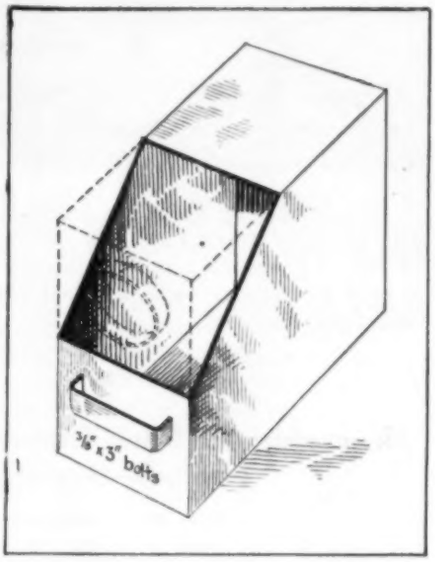
width is mounted on the arbor and is set central with the axle by means of a square and a slip gage of the correct length, as shown in the illustration. After cutting the first keyway, and without disturbing the setting of the axle, the table is traversed to bring the opposite end of the axle into position. An end mill is substituted for the arbor and the knee of the machine is raised to bring the centers of the axle and the end mill in alignment. The precise relative positions are found by a slip gage of the correct height, one end of the gage resting on the table while the other end is in contact with the end mill. The second keyway is then milled.

Assuming that the keyways are each to be 2 in. in width, and that the axle is 8 in. in diameter, the slip gage used between the cutter and the square will be 3 in. in length. The height of the slip gage between the table and the end mill will be equal to the center height of the axle above the table, minus one-half the diameter of the end mill; in this case 6 in.

Shop Bins From Old Cans

Frank C. Hudson

Old varnish cans make very good metal bins for bolts, nuts, washers and the dozens of small parts that any small shop has to carry. A small boat builder of my acquaintance uses dozens of these can to good advantage. He simply cuts off the corner containing the spout, as in the illustration. The handle is located just right to act as a drawer-pull, and on all the larger sizes there is ample room for a label below the handle. Varnish cans are standardized sufficiently to make a very good looking collection of drawers or bins, and they come in such different sizes that they are particularly convenient for many small shop supplies. Most of us consider varnish cans too sticky and messy to bother with when empty, but a little turpentine cleans them easily and they will help keep the average shop looking better than is usually the case.



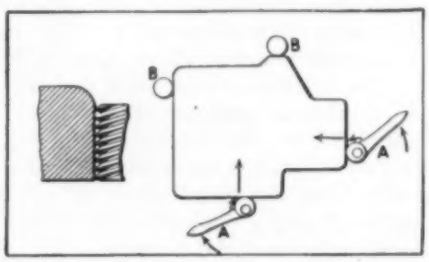
■

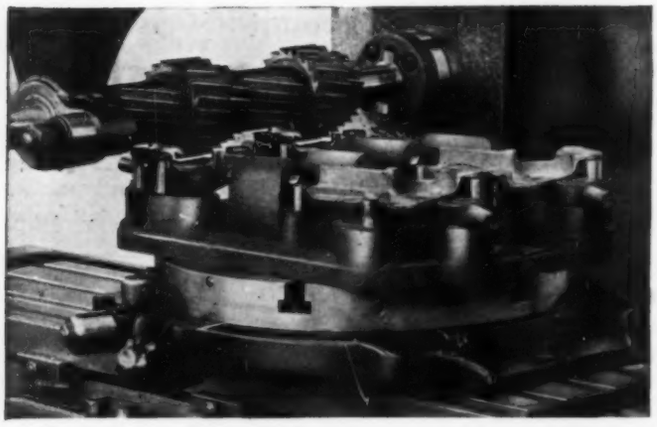
Efficient Eccentric-Screw Clamps

T. H. Abney

Quite often it is necessary to machine work in which there are no ears or pads for clamping it in the fixture. To overcome the difficulty of clamping such work, the eccentric-screw clamps shown in the illustrations were designed.

The clamps consist of cylindrical pieces, bored eccentrically, threaded, and provided with levers for turning them. When the clamps are placed over studs in the fixture, as at *A*, Fig. 1, turning them causes the parts farthest from the centers to advance toward the work, into which the sharp threads bite. Threaded studs, as at *B*, are placed in the fixture as nearly directly opposite the clamps as is possible. Thus, when the clamps are tightened, the threads on the studs bite into the work as well as do those on the clamps, insuring a good grip. The threads are cut either right- or left-hand, according to the direction in which the clamps are to be turned.





so that in turning them the helix angle of the threads will naturally force the work down upon its supports. In Fig. 2 is shown a milling fixture in which the work is held by several such threaded clamps and studs as have been described.

■

Measuring the Pitch Diameters of Taper Threads—*Discussion*

ANDREW J. SCHWARTZ

Being interested in the designing and gaging of threads, the article by Charles Kugler under the title given above (*AM*—Vol. 74, page 730) attracted my attention. Complying with the editor's note at the bottom of the article the following is submitted, not as a new method of measuring pitch diameters, but to call attention to the fact that the method of using a gage to locate the measuring point, specifying the use of prussian blue, and the exact formula are given in the 1924 issue of the report of the National Screw Thread Commission, and again in the revised 1928 edition of the report.

There is, however, one thing that, while it is not vital, is important because it leads to confusion. That is the use of the term "Briggs" standard, instead of the American National Taper Thread standard. The original Briggs standard has not the same form of thread as that now in use. The designation "Briggs" was superseded by the term "American" for standard pipe threads in 1919 by a committee of manufacturers on the standardization of fittings and valves and of the A.S.M.E. on international standards for pipe threads. The standard under the new name was published in October, 1919, under, "Manual on American Standard Pipe Threads."

This thread was also known as the "National" standard according to the N.S.T.C. reports of 1921 and 1924, but in the 1928 revised edition, the designation was changed to the present one of "American" National Pipe Threads. Incidentally, in the 1928 report is given the method of obtaining the pitch diameters of taper threads by using two wires only. This method requires less computation and is independent of the type of thread.

The opinion is expressed that all parties interested in screw-thread products should have available a copy of the 1928 revised edition of the report of the National Screw Thread Commission (procurable for a nominal sum from the Superintendent of Documents, Government Printing Office), and follow the data and the nomenclature given therein.

SEEN AND HEARD

●

If We Lost New England

NEW ENGLAND, once considered lost industrially, has come back and then some. In that connection, the spectacular "concentration" of 673 airplanes in an army defense maneuver over New England—ballyhooed in the press as a great "show"—really had at least one other aspect. Just how wartime capture of the New England states would affect our national defense has been unearthed by the New England Council. Loss of the six New England states would deprive the country of 18,000 manufacturing plants producing six billion dollars worth of products annually, in which metal manufactures predominate. Percentages of the nation's production produced in these states are revealing. Some of the larger percentages are: Firearms, 74.4, worsted goods 68.9, cotton small wares 64.7, woolen goods 63.2, boot and shoe findings 63.1, textile machinery 62.3, emery wheels and abrasive and polishing appliances 61.8, cutlery and edge tools 58.7, and clocks 48.9.

Swaging Inside Out

SWAGING, as most shop men know, is nothing more nor less than a peening or hammering operation designed to reduce the outside diameter of bar or tubular stock. Perhaps it is less generally realized that swaging makes the surface of the metal harder and gives it a smooth surface somewhat like one that is rolled or burnished. A similar effect is produced on die and other surfaces by the so-called "Cloudburst" machine. Now comes an ingenious application of what is really a swaging process for producing a harder and smoother surface on the interior of bushings and bearings. In this case the rollers do the hammering. They are forced outward against the surface to be treated by a cam that rotates inside the carrier which holds the rollers in much the same way that the hammer blocks used in rotary swaging machines are forced inward against the die. In this case, however, the action is reversed so that the rollers do the work against an inside diameter. Certainly such an operation will take the tool marks out of a bearing surface and ought to reduce the running-in period required almost to zero.

Chromium Plate for Cutting Tools

ALTHOUGH chromium plating of cutting tools such as saws, drills, milling cutters, files and the like is not a new idea, it is reported to be highly beneficial in increasing the life of such tools. One plater who has done much work of this description told us recently that the beneficial results are not properly attributable to the hardness of chromium itself, but to something resembling the action of a lubricant. Contrary to general belief, he said, a thick coating of chromium is not required; the adhesion of this coat at the extreme cutting edge is not so important as is the protection of the tool surface a short distance back of the cutting edge where the erosive action of chips wears the tool away and permits the edge to chip. Plating for this purpose should be followed by heating the tools just enough to drive off hydrogen and prevent embrittlement.

A Record for Machine Equipment

(See chart on following page)

WHILE age is not always proof that a machine is inferior to present-day models, it is wise to consider that natural progress and improvement has always played an important part in the success of American industries. Obviously, the logical procedure would be to determine all the factors that enter into the valuation of any particular machine. It is with this thought in mind that the Union Special Machine Company, Chicago, makes public the system that is used in its own factory, believing that the same method can be applied advantageously by members of the trades for the betterment of their mechanical equipment. By this system each individual machine or each group of machines is provided with a complete "pedigree" which coordinates all of the factors having a bearing on the determination of the degree to which obsolescence exists.

Advantages of the System

Based on observation of the system under actual operating conditions, the benefits derived are the natural result of the favorable conditions automatically produced in adhering to the prescribed procedure. The most important of these may be listed in five principal classifications:

1. The time for taking inventories is reduced, and, in fact, machine operation need not be interrupted at all during these periods.

2. Attention is constantly directed towards each individual machine. Thus, wasteful and inefficient units are quickly detected and exposed, with the evidence of their faulty performance prepared in a form suitable for presentation to those in authority.

3. By this method of directing attention to the mechanical equipment, officials of the operating department are automatically forced to keep in touch with all new developments and improvements in methods.

4. The ordering of replacements and repairs is facilitated, and minimum time is wasted by machines idle during operating time.

5. The financial operations of the company are safeguarded through maintaining a constant balance of the appropriations for new equipment, and as a result, by avoiding unexpected expenditures.

The chief essential of the system is a Machine Equipment Record Card of a form recently copyrighted by the company. This card, illustrated on the following page, provides for the listing of the name of the manufacturer of the machine, the operation performed, the serial number and type of the machine, and also the serial numbers of duplicate machines where a group is involved. Following it is an itemized list of the factors that should be considered arranged in a form that facilitates recording the results obtained through periodic surveys. These are: Date of Survey, General Condition of Machine (Good, Fair or Poor), Date of Purchase, Purchase Cost, Per Cent of Production the machine is capable of maintaining as compared with the latest type of equipment, Quality of Work (Excellent, Good or Fair), Type Designation of the newest machine. In detail the condition of the machine is classified as to whether it must be changed and the estimated cost of change, whether it must be repaired and the estimated cost of repair, whether it must be overhauled, cost of overhauling, and the date recommended for overhauling.

On the basis of this information the machine is then allotted to one of four classifications, of which Class "A" denotes machine equipment which should be replaced with a better machine. Class "B" is the same as "A" except that the urgency for replacement is not so great, Class "C" covers equipment where specific recommendations should be made after Class "A" and "B" machines have been replaced, and Class "D" denotes that the equipment now in use is found to be the best obtainable for its particular function. By the law of engineering progress the class letter of a machine will ordinarily bear a definite relation to the actual age of the machine.

At this point it will be seen that there are a number of other factors that must enter into the decision as to the final disposition of the recommendations. For convenience these are itemized in compact form under the heads of A—Cost of Improved Machine, B—Resale or Trade-in Value of old machine, C—Cost of Change-over, D—Cost of Repairs, E—Cost of Overhauling, and F—The Net Cost of the Improved Machine. The net cost is computed as $F = A - (B - C, \text{ or } D \text{ or } E)$. This means that the computation of the actual cost of a new machine should allow for the resale value of the old machine plus the cost of reconditioning the old machine so that it would continue to operate.

Summing Up Economies

To complete the information required in determining what recommendation will be made, it is necessary to sum up the economies that can be effected with the improved type of equipment. This lists the number of new machines required, the increase in production made possible, the saving in floor space, saving in maintenance and the saving in labor costs (Operation). The conclusions that can be drawn from a comparison of cost and savings are so self-evident as to enable anyone to render an intelligent and justifiable decision.

The back face of the record card contains tabular space for "Data on Various New Equipment Under Consideration," in which the headings are "Make and Type Machine," "Data," "Date" and "Remarks." Information on five machines may thus be tabulated.

Arrangements have been made whereby any manufacturer can obtain a supply of these cards at cost by addressing the Union Special Machine Company, 400 North Franklin St., Chicago, Ill.

© American Machinist

Mach. Mfd. By

Operation

Type Serial No.

MACHINE EQUIPMENT RECORD

Dept. No._____

Serial Nos. Of Duplicate Machines Involved

_____ _____ _____

_____ _____ _____

_____ _____ _____

* ☐ Class A ☐ Class C

☐ Class B ☐ Class D

Date Of Survey	General Condition Of Machine Good Fair Poor	Date Of Purchase	Purchase Cost	% Production Compared To New Type	Quality Of Work-Excel. Good Fair	Type Of New Machine	Condition Of Machine: Must Be Changed	Cost Of Change	Must Be Repaired	Cost Of Repair	Must Be Overhauled	Date Required	Cost Of Overhaul

Computation Of Replacement Cost			Remarks
A = Cost Of Improved Machine			
B = Resale Or Trade-In Value			
C = Cost Of Change-Over			
D = Cost Of Repairs			
E = Cost Of Overhauling			
F = Net Cost F = A − (B + C + D + E)			

Economies Effected			Remarks
Number Improved Type Required			
Increase In Production %			
Saving In Floor Space − Sq. Ft. X Cost Per Ft.			
Saving In Maintenance			
Saving in Labor Cost			
Net Saving			

Replacement Or Addition?

Is New Machine Recommended?

REMARKS:

* NOTE:

Class "A" Denotes Machine Equipment Which For Adequate Reasons Should Be Replaced With A Better Machine.

Class "B" Same As "A" Except Urgency For Replacement Is Not So Great.

Class "C" Covers Equipment Where Specific Recommendation For Replacement Should Be Made After Class "A" & "B" Machines Have Been Replaced.

Class "D" Denotes That Equipment Now In Use Is Found To Be The Best Obtainable For Our Particular Work.

NOTE:

Card To Be Made Out For Each Individual Machine Or For Each Individual Group Of Machines.

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• • • • SHOP EQUIPMENT NEWS

Landis Type C 6-In. Plain Hydraulic Grinder

A small but highly flexible 6-in. hydraulic grinder is being announced by the Landis Tool Company, Waynesboro, Pa. This type C machine is a rapid-traverse type and is recommended for such work as universal-joint spiders, small bearings, small motor armatures, light shafts and work of a similar nature. The outstanding features are its productiveness and ease of operation, the latter achieved by smoothness of all machine movements and by a skillful grouping of controls. The hydraulic table traverse gives a range of table speeds from 6 to 240 in. per min. Depending upon the use to which the machine is to be put, other hydraulically controlled movements may be supplied.

Accessibility to the various mechanisms is another feature. By removing the large cover at the front of the bed, all control mechanisms are exposed. None of them is entirely within the bed. The design of the complete pump mounting is also such as to make it accessible.

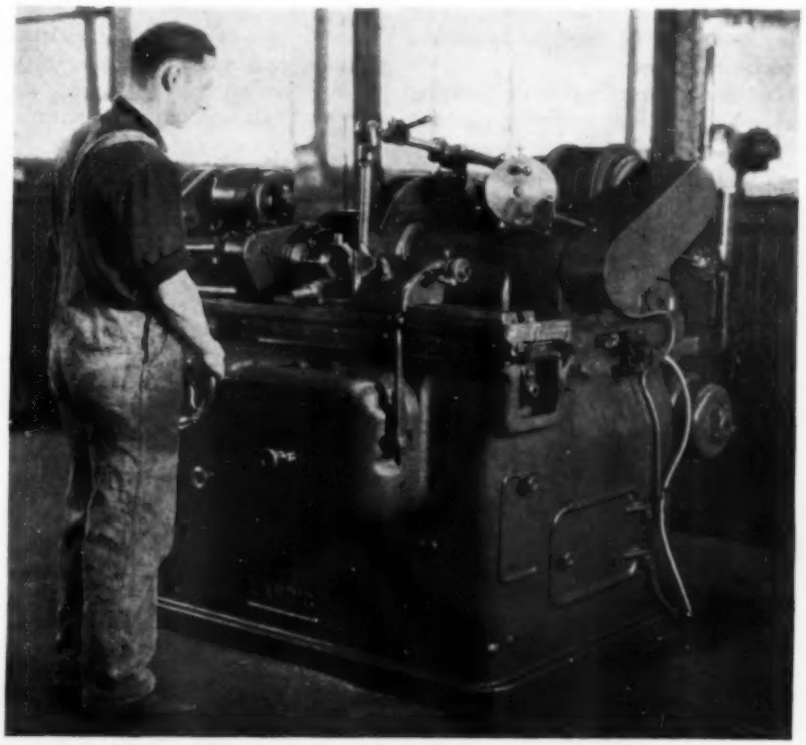
The bed is of box-type construction, and the water reservoir is cast integral with it. The base forms a reservoir for the oil used by the hydraulic traversing system. The work carriage traverses on a flat guide and a V-guide with one vertical side, both guides having chilled surfaces. Guide-way lubrication is of the flood type, filtered oil being used, and being supplied by the same oil pump that furnishes pressure for the hydraulic system. Provision is made for dwelling the work carriage at the reversing points.

The grinding wheelhead is also supported by a V- and a flat-guide with chilled surfaces. Steel-back babbitt bearings are used for the wheel spindle, the lubrication being supplied continuously and being filtered before entering the bearings. The grinding wheel spindle is driven at the right-hand end through multiple V-belts from a balanced motor. This motor is mounted on the top of the wheel-base casting at the rear. An 18 x 1½ x 8-in. grinding wheel is considered standard.

The hydraulic system consists of a twin-cylinder table traversing mechanism and a Tuthill internal geared oil pump. Through the use of twin cylinders, smoothness of operation is assured because the control valve is made to govern the flow of oil from the end of one cylinder into the corresponding end of the other. The oil pump is mounted on the rear of the bed, where it, along with the water pump, is driven by a constant-speed motor. All drives are completely enclosed.

Standard equipment includes a plain wheel-feed mechanism. At extra cost an hydraulic automatic wheel-feed mechanism may be supplied, or for certain high-production jobs an hydraulic straight-infeed mechanism is also available. The headstock is driven by a constant-speed motor. Four work speeds are made possible by changing the pulleys and the belts at the left-hand end of the head.

The type C grinder is available in a 6x18-in. size which weighs 3,750 lb. net, without electrical equipment, and also in a 6x30-in. size which weighs 4,000 lb. net, without electrical equipment. Constant-speed motors are used throughout; a 1/3-hp. motor for the headstock, a 1-hp. motor for the pump drive, and a 3-hp. motor for the wheel-spindle drive.



High productivity and ease of operation are the outstanding features of the Landis Type C 6-In. Plain Hydraulic Grinder, which has hydraulic table traverse at speeds from 6 to 240 in. per min.

"Pfauter" Model S.R. High-Production Wormwheel Hobbing Machine

Introduced into the United States by the O. Zernickow Company, 15 Park Row, New York, N. Y., the "Pfauter" Model S.R. high-production wormwheel hobbing machine offers three methods of feeding. These methods are: (1) radial feed of the tool towards the gear; (2) axial feed of the tool towards the gear, and (3) combination of radial feed for roughing and axial feed for finishing. Fly cutters can also be employed, and for this purpose an indexing and cutting device is provided.

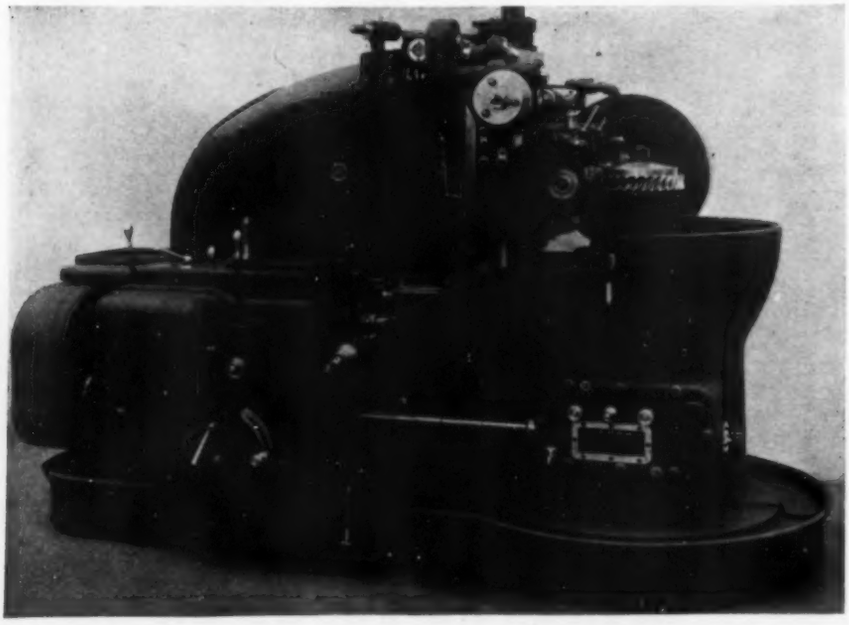
The main drive is by single pulley direct from the lineshaft or by a motor through a belt or gearing. A friction clutch permits the machine being started or stopped from the operator's position. From the main drive power is transmitted by spur and bevel gears and spline shafts to a large flywheel internal gear located directly on the cutter spindle. This flywheel gear and a second flywheel on the fast running vertical shaft insure quiet and smooth running. The cutter speed can be changed by means of pick-off gears.

The slide carrying the hobbing head is adjustable vertically on the upright for setting the cutter axis with the center of the wormwheel. The hob spindle sleeve is mounted on a swivel base, which allows the cutter axis being swivelled a few degrees each side of zero. A worm drive and a scale and vernier are provided for this purpose. On the swivel base is mounted the slide which effects the axial movement of the cutter. Radial movement of the hob or cutter towards the work is effected by moving the machine upright together with the whole hobbing saddle on the long and wide dove-tailed guides on the bed.

The index drive has been designed for small ratios between the cutter spindle and the work spindle when dealing with small numbers of teeth and multiple-start worm drives. The minimum ratio, that is, number of teeth in the gear to the number of starts in the worm, is 4. The dividing gear is mounted on the underside of the work table in such a way that its guides are adjustable in both directions. The worm is hardened and ground all over and is adjustable radially and axially. Drive is taken through index change gears.

The work is mounted on the vertical arbor and placed low down on the work table, which is provided with T-slots. Both the radial and axial feeds of the hob operate independently and are interlocked. Both feeds disengage automatically at a given axial distance. The cutter drive can also be made to stop automatically with the feed knockoff. Both the hob slide and upright have quick power travel. Lubrication of the machine is effected automatically.

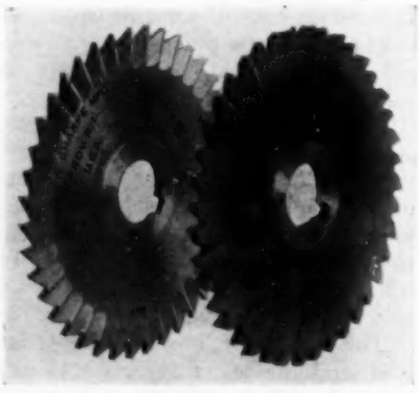
Specifications: maximum diameter of wormwheel, 19¾ in.; maximum pitch, 1½ C.P.; maximum diameter of hob, 6¼ in.; diameter of work table, 15¾ in.; hob speeds, 52 to 154 r.p.m.; power required, 7½ hp.



"Pfauter" Model S.R. High-Production Worm-Wheel Hobbing Machine from the operating side. Worm wheels up to 19¾ in. are hobbed

Brown & Sharpe Metal-Slitting Saws with Side Chip Clearance

Twenty-one sizes of metal slitting saws with side chip clearance have been added to the line manufactured by the Brown & Sharpe Manufacturing Company, Providence, R. I.



Left—Brown & Sharpe Straight-Tooth Slitting Saw. Right—Staggered-tooth slitting saw

These saws of high-speed steel permit the chips to be carried out of a deep slot without jamming. In addition, to the pockets at the sides of the teeth, the sides of the saws are recessed. A concavity of the lateral cutting edges is also provided.

Saws are made in diameters from 3 to 8 in., and in a suitable range of thicknesses. The teeth of saws up to and including 5/32 in. thickness are made in the conventional straight-tooth type, whereas saws of $\frac{3}{16}$ in. thickness are made in the staggered-tooth type.

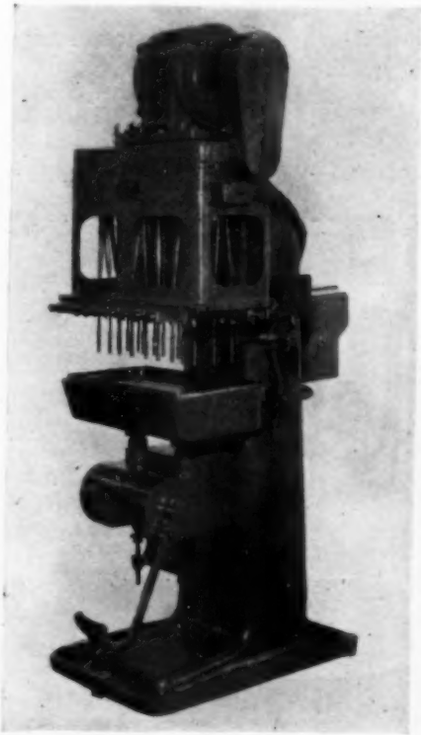
Ex-Cell-O Semi-Automatic Drilling and Tapping Machine for Small Holes

A multiple-spindle machine for drilling and tapping work while submerged has been designed by the Krueger Division of the Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, Mich. Twenty-one fully adjustable spindles are provided on the machine, with a minimum center distance of 7/16 in., and the spindles are designed for drilling or tapping holes up to ¼ in. The work is flooded during the working operation.

Suitable fixtures are mounted on the table, which is raised to meet the drills or taps. The table proper is mounted on two plungers within a tank or container, which is filled with the cutting compound. The whole table unit is so designed that when the pedal is pressed downward the center work table remains stationary for a portion of the stroke while the outer or tank portion moves upward. This relative movement causes the work to be submerged in the cutting fluid in the tank portion of the table, and it is at this time that the drilling or tapping operation is performed. When the pedal is released, the center table with the work again emerges from the cutting fluid and the operator is able to unload and reload.

The table assembly is counterweighted so that the weight of the fluid, together with that of the work and work table, is so balanced as to insure ease in operating the pedal. The outer, or tank table, is mounted on hollow rack guide bars through which extend two plungers supporting the work table. At the bottom of these plungers are two adjustable setscrews which govern the downward movement of the work table. Another feature is that the tapping spindles are threaded through their support arm to the correct lead for the thread of each individual tap. By this arrangement the taps are fed into the work correctly, and eliminate the possibility of cutting away or stripping the first few threads of the hole being tapped. A reversible motor is provided with the machine when tapping is to be done.

The spindle drives are of standard universal-joint construction and afford the range of center distances provided. Three cluster gears driving through worm gears operate each group of spindles in the upper portion of the head. The worm shaft and motor are connected by means of Texrope drive to insure quiet and vibrationless operation.



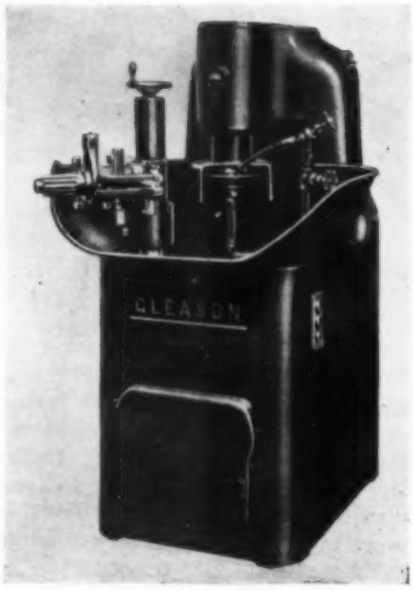


Fig. 1—Gleason No. 6 Spiral Cutter Sharpener

Fig. 2—Cutter and grinding spindle on the No. 6 Spiral Cutter Sharpener

Gleason No. 6 Spiral Cutter Sharpener

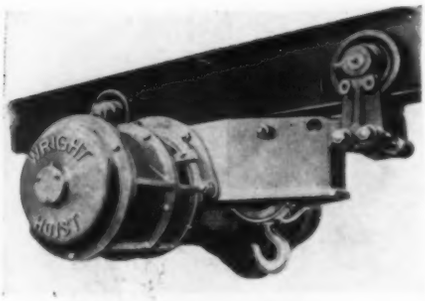
For sharpening the small circular cutters used on its spiral-bevel gear generators, the Gleason Works, 1000 University Avenue, Rochester, N. Y., is offering the No. 6 spiral cutter sharpener. It will sharpen cutters up to and including 6 in. in diameter for cutting by the spread blade, duplex spread blade or standard method; that is, cutters with either all inside or all outside, or both inside and outside cutting blades.

The cutter to be sharpened is mounted on the cutter spindle, which is adjustable for setting to any desired cutting angle. The spindle head is swung to and fro to move the cutting edge of the blade across the face of the grinding wheel. The proper setting of the cutter is obtained with a conveniently located hand nut, and a gage is provided for checking the sharpening of the cutter. Grinding is always done against the cutting edge of the blades, reducing the possibility of burning them and preventing a burred edge.

The wheel spindle is driven by a 1-hp., 1,800- or 1,500-r.p.m., constant-speed motor mounted in the base and connected to the spindle by means of a belt. The floor space required is 31x39 in., and the net weight is 1,500 lb.

Wright Low-Headroom Electric Hoists

For use where the head room is excessively low, the Wright Manufacturing Co., Bridgeport, Conn., is offering the electric hoist illustrated. For the hoist of ½-ton capacity, the



Wright Low-Headroom Electric Hoist

minimum distance from the bottom of the I-beam to the hook is 11 in.; for the 1-ton hoist, 13 in. Drums and sheaves are of ample size to avoid excessively sharp bending of the cable, which otherwise would result in undue wear.

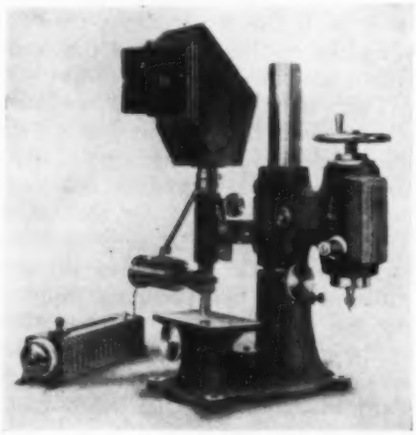
Push-button or pendant rope control are optional, both at the same price. The equipment includes a safety limit switch, a safety load block, positive mechanical brake, heat-treated forged gears, and preformed wire cables. Lubrication of the mechanism is by an oil bath.

Firth Hardometer Hardness Testing Machine

The Firth Hardometer hardness testing machine, manufactured by Thomas Firth & John Brown, Ltd., Sheffield, England, is being introduced into the United States by the Tinius Olsen Testing Machine Company, 500 North 12th St., Philadelphia, Pa. This machine operates on the standard Brinell principle, but uses lighter loads and either a small steel ball or a diamond pyramid as an indenter. The small steel ball is used on thin or soft materials and the diamond indenter on the hard materials such as carehardened, cyanided, or nitrided surfaces.

This machine has a micro-projection head which has the advantage of quicker readings so that it is especially adaptable for quantity production purposes. Loads of 120, 30 or 10 kg. are used, depending on the general character of hardness testing to be done. With the 120 kg. load, hard and medium steels down to 1 mm. thick or soft metals down to 2 mm. thick can be tested. This covers the average range of materials tested, and is the capacity generally used. With the 30 kg. load cylinder, similar materials down to ½ mm. or 1 mm. thick may be tested. The 10 kg. load cylinder is used for very thin materials.

The Firth Hardometer differs from other instruments for hardness testing in that the diameter or diagonal



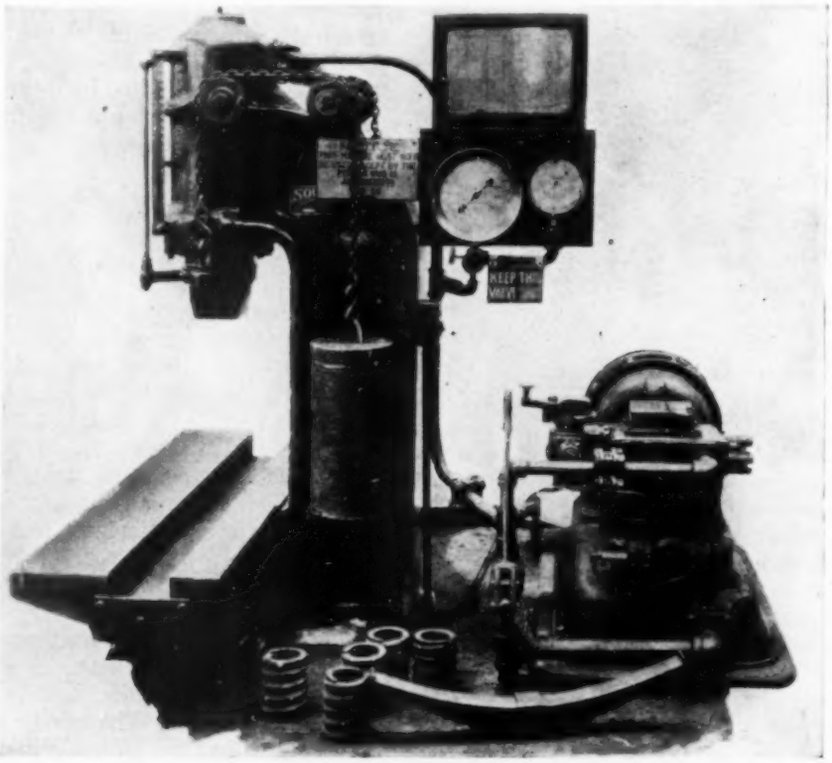
Firth Hardometer Hardness Testing Machine with a micro-projection head and a 30-kg. load cylinder

of the impression is measured instead of the depth. The diameter or diagonal is from eight to sixteen times as great as the depth of impression, so that the instrument gives accurate and consistent results. In addition, a microscope is furnished to permit greater accuracy of reading. The indenter head and microscope are carried on two arms on a frame which can be quickly swung about a vertical center support post. With the micro-projection head the size of the indentation is shown on a ground glass directly before the eyes of the operator.

Ryerson Testing Machine for Railroad Springs

A special railroad spring tester has been developed by Joseph T. Ryerson & Son, Inc., Chicago, Ill., for use in the Van Nest Shops of the New York, New Haven & Hartford Railroad. This machine does not depend upon an accumulator to supply the hydraulic pressure, which is furnished by a self-contained, motor-driven Oilgear unit. Through the use of the Oilgear system, a spring may be deflected at any desired pressure for three or four minutes at a time. A maximum pressure of 50 tons is developed at 1,500 lb. per sq.in. for the system.

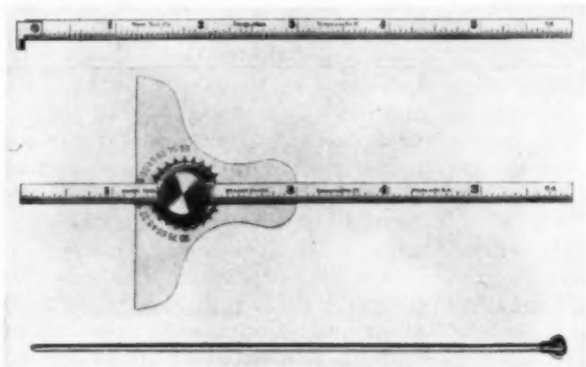
The machine is arranged for testing full-elliptic springs for passenger cars as well as semi-elliptic locomotive and coil springs. The frame has an 11-in. throat and a worktable 25 in. wide, both made of cast steel. A scale is mounted on the overhead ram cylinder to indicate the deflection of the spring being tested. A large



pressure gage, having two dial readings, indicates the pressure in pounds per square inch and the total ram pressure in pounds.

Union No. 331 Adjustable-Angle Depth Gage

The No. 331 adjustable-angle depth gage has been announced by the Union Tool Company, Orange, Mass. The head of this tool is marked on both sides of the adjusting stud as follows: 15, 30, 45, 60, 75 and 90 deg. To obtain the angle wanted, the nut is released about one-quarter turn and the rule is turned until the line



on the washer matches the desired angle. At this point the indexing finger on the washer will drop into a slot, and hold the rule in the correct position. After the nut is tightened the tool is ready for use. For measuring holes too small for the rule, a rod 6 in. long and 3/32 in. diam., is furnished. The rod is inserted in the milled groove and the nut tightened.

The No. 431 hook rule can be used with this gage, making it a caliper rule.

Vickers Hydraulic Relief Valve

A hydraulic relief valve (balanced) has been announced by Vickers, Inc., 7742 Dubois St., Detroit, Mich. Instead of the customary spring-loaded construction, the valve is operated by a piston that is in hydraulic balance regardless of the initial oil pressure and the pressure for which the valve is set. Consequently, it is sensitive and accurate throughout the pressure range. The valve can be installed directly in the line and in any position. This eliminates the customary

Vickers Hydraulic Relief Valve, which has a balanced piston

tee and results in a neater and more compact installation. Longer life is assured by the alloy-steel working parts that are hardened and ground.

A hydrocone-shaped valve prevents wire drawing and eliminates oil foaming, which aerates the oil. The valve is non-surging and the operation is quiet because of the employment of the balanced piston.

The valve is made in two sizes for $\frac{3}{4}$- and $1\frac{1}{4}$-in. pipe connections, and the capacities are 0 to 15 gal. per min. and 10 to 40 gal. per min., respectively. The pressure range for both valves is from 0 to 2,000 lb. per sq.in.

"Crescent" Tape-Rule

A 6-ft. tape-rule has been placed on the market by the Lufkin Rule Co., Saginaw, Mich., under the trade name of "Crescent." It has an accurate steel tape that automatically winds into a sturdy case 2 in. in diameter, and yet when completely withdrawn is rigid because it is of tempered steel, stiffened by special forming. The rule is nickel-plated and has prominent dark markings in inches to 16ths for the No. 696, and in 10ths and 100ths of a foot (engineers' measure)

for the No. 696D. Unsupported, the rule may be projected to the full distance, and it will also flex around and accurately measure circular, round-cornered and other shaped objects. The solid clip at the first end serves for withdrawing the rule blade from the case and also as a hook for taking measurements out of arms reach. The rule blade is returned automatically by pressing the center button. Thus, the rule cannot fly out of the case at high speed. The case is chromium-plated, and has a smooth-working spring-winding device with a ratchet stop.

Forbes & Meyers Welded Tool Grinder

A tool grinder of all welded steel construction has been placed on the market by Forbes & Meyers, 172 Union St., Worcester, Mass. This design saves 175 lb. weight and the price is considerably reduced. The

grinder has 10x1-in. wheels, mounted on the motor shaft, and operates at 1,800 r.p.m. A toolrest is provided on the left end only. It is adjustable in two directions. The right-hand wheelguard has a large opening for work which cannot be handled on the regular toolrest. Both wheels have permanent guards. The ball bearings employed are of the grease-seal type, packed in sufficient

grease for one year of ordinary use.

The motor is inclosed from the outside air, but air circulation through the stand serves for cooling. It is of the induction type and is rated at ¾ hp. The switch is mounted in the base. Knockouts are provided at several points in the base so that wires can be run from the switch to the power lines in any direction. Standard finish is either machine tool grey or black.

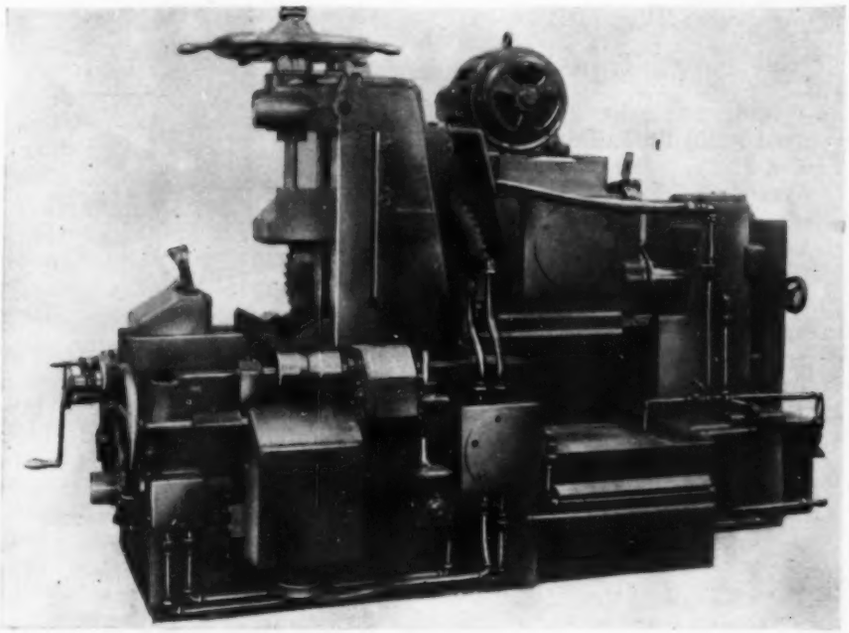
Heller Type S-HS High-Duty Hydraulic Cold Metal Sawing Machine

A fully hydraulic cold metal sawing machine is being offered by the Heller Machine Company, 25 Church St., New York, N. Y., in five sizes ranging in capacity from 5 to 18 in. rounds. The machines are primarily intended for the rapid cutting of bars, billets, forged stock and structural shapes. They are additions to the previous line of mechanical-feed equipment.

The drive is through a single pulley with motor mounted on the saw carriage, and complete control is centralized at the front of the machine. The bed is of extra heavy, box-section construction, and the carriage runs on wide, flat ways and is gibbed for longitudinal adjustment. All gearing is of chrome-nickel steel, heat-treated. Shafts run on ball or roller bearings, and the saw arbor on tapered roller bearings. Sliding gears operate on multi-splined shafts. The saw-head gearing is lubricated through a separate oil pump. Four speed changes to the saw blade are secured by a single lever by means of sliding gears.

The carriage feed has a range from 0 to 20 in. per min. Adjustable knock-offs automatically disengage the feed at the end of the cut and return the carriage to the starting position by rapid traverse. The blade cuts upward through the stock, and thus seats the carriage firmly on the ways, directing the stress of cutting downward into the heavy bed section where it is absorbed.

The vertical work clamp is hydraulically operated, and is further equipped with a hammer-type handwheel moving only a quarter-turn to clamp the stock with a hammer blow. This relieves strain from the operator when cutting a variety of diameters or shapes where the hydraulic clamping would be at a disadvantage. The front or horizontal clamping vise can be arranged either for mechanical or hydraulic operation.



The stock-moving mechanism comprises a V-type roller operating continuously and carried upon a vertically operated slide. This vertical slide is operated hydraulically to lift the stock from the clamping block and move it forward by power against the stock stop. By means of a handwheel arrangement the stock can be moved either forward or backward independent of the lifting mechanism and the power feed drive. This unit can also be furnished for mechanical operation. The outer end of the stock is carried upon an adjustable stock carrier running upon rails at right angles to the machine bed.

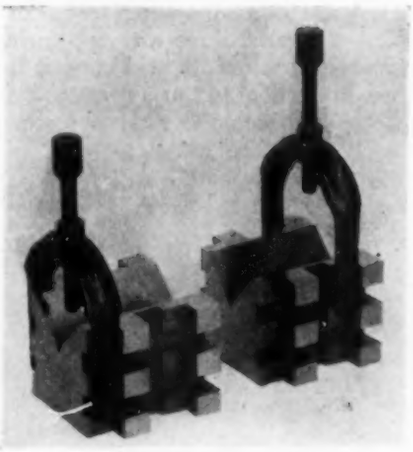
After setting the machine for the proper blade speed, feeding and cutting length, the movement of one lever opens the vertical vise and the horizontal vise, raises the stock lifter and moves the stock forward for the next cut. Another lever is thrown in for the feed engagement, and at the end of the cut the carriage returns automatically to the starting position by rapid traverse.

Machines can be furnished with hydraulic carriage feed only and with other units mechanically operated, or with any desired combination of hydraulically and mechanically operated units.

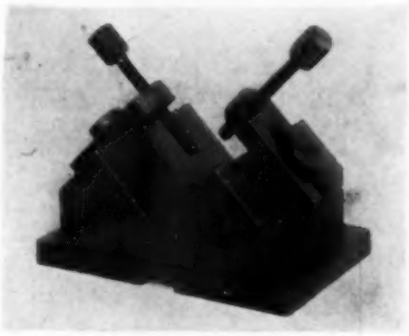
Brown & Sharpe Nos. 750B and 750C V-Blocks and Clamps

Two types of V-blocks and clamps have been developed by the Brown & Sharpe Manufacturing Company, Providence, R. I. The No. 750 B V-blocks and clamps have stepped clamping lugs and are suitable for inspectors' use. The blocks can be used on their sides as the clamps do not project. The stepped construction also allows changing the clamps quickly from small work to work up to 2 in. in diameter. The blocks are ground in pairs and all sides are at right angles. Thus, they can be used in any position. Each block is of hardened steel 2½ in. long, 2¼ in. wide and 2 in. high.

The V-block No. 750C leaves the entire top side of the work accessible. The clamps are designed to hold stock of square or rectangular cross-section, as well as round stock. A hole through the center of the block allows



Brown & Sharpe No. 750B V-Blocks and Clamps



Brown & Sharpe No. 750C V-Block

drills and drifts to project through the work. A tongue in the bottom is a convenience when the block is used on a machine table, where the block can be clamped conveniently by the flanges. The block is also satisfactory for relatively light work being done along the top side of the stock. The block is of hardened steel 3 in. long, $4\frac{3}{4}$ in. wide, 2 in. high and is ground on its bottom. It has capacity for round stock up to $1\frac{1}{2}$ in.

Fellows Helical Gear Shaper Cutter and Cutter Sharpener

A cutter for finishing helical gears on the gear shaper has been developed by the Fellows Gear Shaper Company, Springfield, Vt. Instead of the cutting edges of the cutter teeth being ground at right angles to the helix, and with a top rake of 5 deg., this so-called "flat-top" helical cutter is sharpened by a generating action, giving a positive top rake to the cutting edges of approximately 7 deg. In this cutter every point on the involute cutting edge is in a plane parallel to the back of the cutter, resulting in no distortion in the profile generated. The cutter is recommended for use in all cases where the pitch is 12 and coarser.

In connection with this helical cut-

Fig. 1—Improved type of helical gear cutter for use on the Fellows Gear Shaper

ter, a special machine has been developed for sharpening the generated edges on the cutter teeth. The front view of this machine, Fig. 2, shows that the head holding the grinding or sharpening wheel can be adjusted to the desired height and can also be set

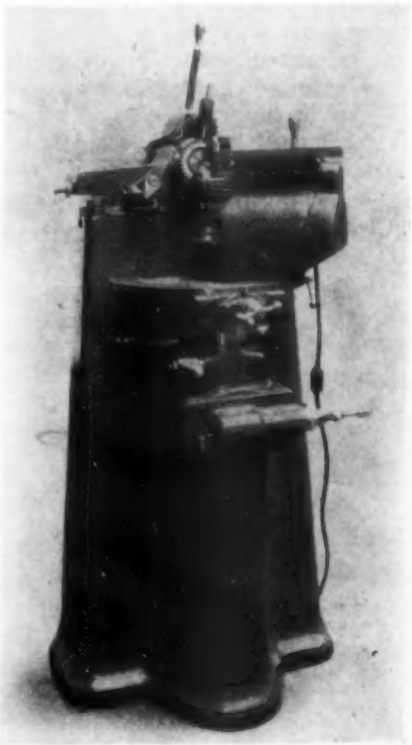
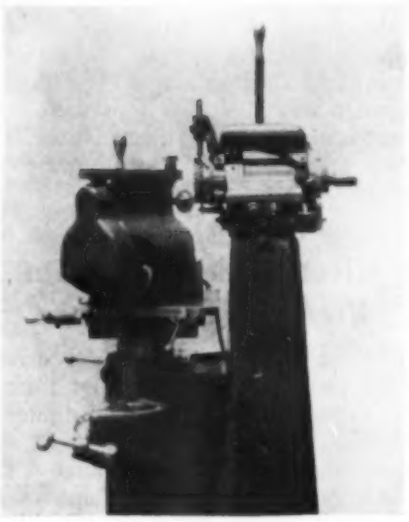


Fig. 2—Front view of Fellows machine for sharpening "flat-top" helical gear shaper cutter

to the desired angle for sharpening. This wheelhead is mounted on a column and can be swivelled to the desired sharpening angle. The cutter is mounted on a horizontal spindle, the latter being retained in a slide. This slide carries the involute control mechanism, indexing dogs, and locating plunger.

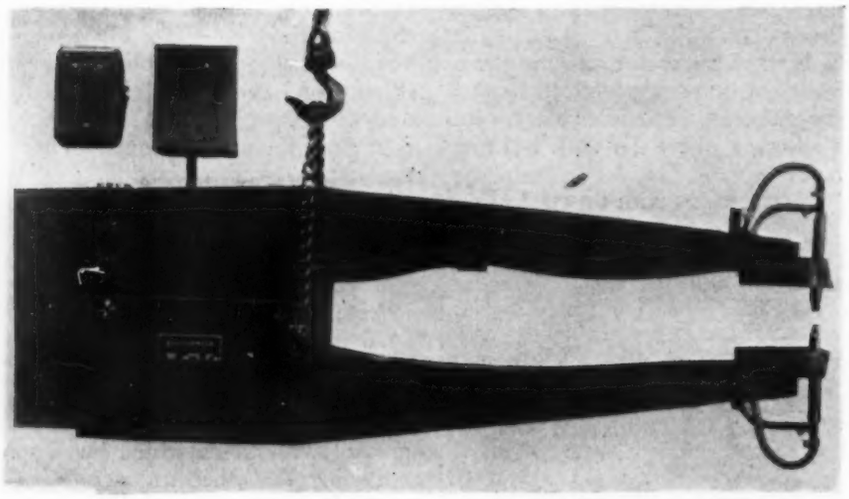
The cutter spindle is controlled in its rotation by a rack and master gear, so that the cutter is given an involute rolling action corresponding to the involute on the cutter tooth itself. Both sides of the cutter teeth can be ground with the machine by simply swiveling the wheelhead.

Fig. 3—Right-hand end view of Fellows machine for sharpening the "flat-top" helical gear shaper cutter, showing the sharpening control mechanism



"Electroweld" Universal Spot and Arc Welder

An "Electroweld" universal spot and arc welder, designated as the "Electric Ironworker" has been placed on the market by the Electric Arc Cutting & Welding Company, 152 Jelliff Ave., Newark, N. J. This arc-welded machine has a throat depth of 48 in., and may be transported about the shop for fabricating work. It can be suspended from a trolley or jib crane or placed on a welded pedestal. Capacity is two pieces of $\frac{3}{16}$-in. steel for spot welding, or up to 200 amp. for arc welding. The change from one operation to the other is made by moving a switch. Compressed air actuates a toggle for

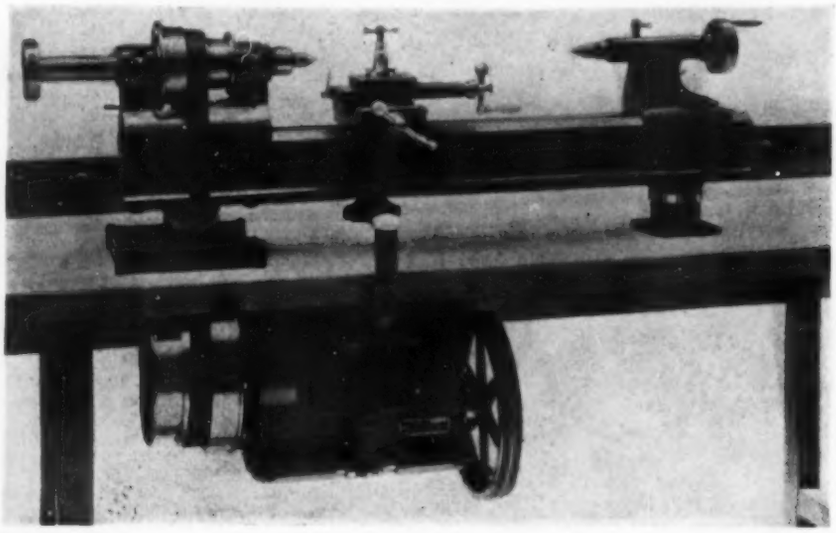


"Electric Ironworker" Combined Spot and Arc Welder, which has a throat depth of 48 in.

clamping, the degree of pressure between the electrodes being adjustable by means of a sliding weight on a balance arm. Exhaust air is used for circulating the water from the reservoir at the rear to the tips. The transformer windings give four steps of heat control, ranging from 50 to 200 amp. and independent of the primary control.

Rivett Series 507 Plain Precision Bench Lathe

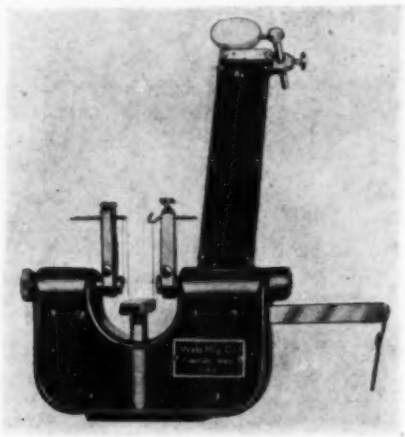
Instead of speed-box motor drive with pedal control, the Rivett Lathe & Grinder Corporation, Brighton, Boston, Mass., is now prepared to equip the Series 507 bench lathe with speed-box motor drive and hand lever control. The lathe is mounted on jack pedestals and has a belt guard. The upper shaft of the speed box carries a three-step driving cone pulley, and thus with the two positions for hand lever, high and low, six speeds are available. Drive from the motor to the speed box is by means of two V-belts to eliminate vibration.



"Wells" Rapid Inspection Gage

A reading magnified 300 times is the feature of the rapid inspection gage announced by the Wells Manufacturing Company, P.O. Box 613, Greenfield, Mass. For measuring screws or taps, either anvils or the three-wire system may be employed. The anvils produce the same results as the tapped hole. The anvils are opened by the pedal and closed by a spring which insures constant accuracy of measurement.

By using flat anvils, either round or flat pieces can be inspected rapidly. The gage is set by using a standard plug. For the three-wire measuring system, the wires are held in place for fast inspection and are adjustable so as to distribute the wear over their full length. They are held loosely but are always in the right position.



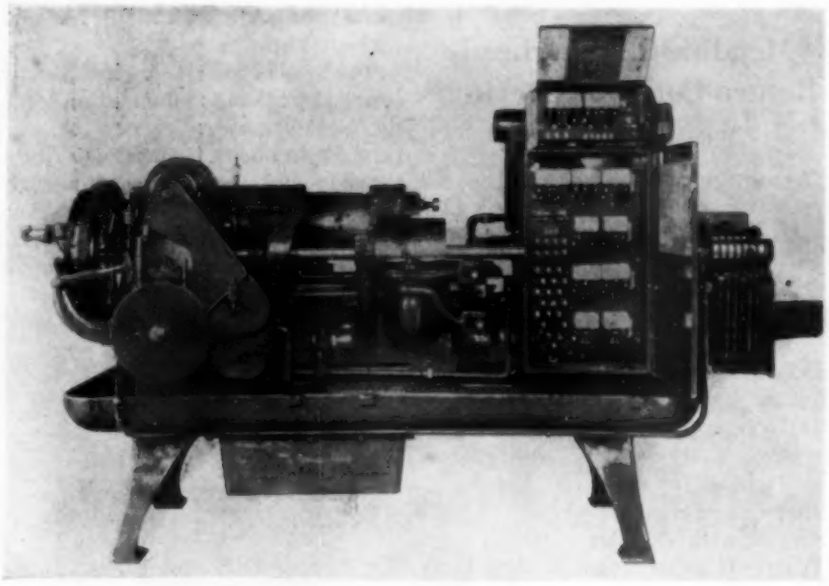
Wells Rapid Inspection Gage fitted for 3-wire measuring

Wells Rapid Inspection Gage fitted with anvils

Regular equipment consists of a gage as shown with a treadle, but without the anvils and wires. A small electric light with a hood can be furnished to make for easier reading of the gage.

Allen-Bradley A.C. Control for Automatic Screw Machines

The Allen-Bradley Company, 122 W. Greenfield Ave., Milwaukee, Wis., is now prepared to furnish a special a.c. control panel for the Cleveland Model A automatic screw machines.



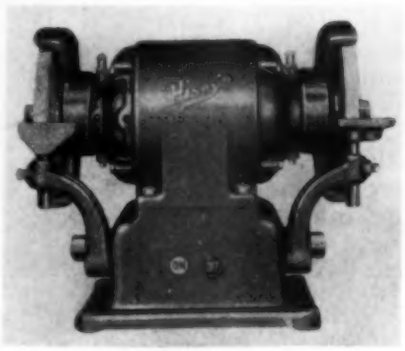
Rear view of Cleveland Model A Automatic Screw Machine fitted with Allen-Bradley A.C. Electrical Controls

This arrangement substitutes electrical control for the usual mechanical control. The screw machine is equipped with a four-speed motor to operate the spindle. The four-speed Allen-Bradley starter is located in the lower control panel. The starter consists of eight magnetic switches and a pair of thermal overload relays. It also contains an additional switch to control the constant-speed feed motor. Mounted above the four-speed starter is the "A-B" reversing switch. The machine is so geared that eight operating speeds are provided, as well as a reversing speed. The correct operating speed is thus provided for all of the various cutting operations of the machine.

The starter is controlled by a pilot control contactor operated by six levers in the small box at the end of the machine. These levers are actuated by dogs, which can be set according to the speed of operation desired. Only two levers can be engaged at one time, one of the direction levers and one of the four speed levers. When one is kicked in, the lever previously engaged is kicked out.

Hisey-Wolf Bench Grinder With 6- and 7-In. Wheels

A 6- and 7-in. wheel grinder built by The Hisey-Wolf Machine Company, Cincinnati, Ohio, is now equipped with an improved commutating-type, repulsion-induction motor



to comply with the more stringent electric codes now in effect in many localities. The starting current under all conditions is unusually low, being less than one-third the current consumption of a split-phase motor. Low voltage due to line drop has no effect on this motor. In addition, this improved, commutating-type, repulsion-induction motor has no dragging centrifugal switch and will start and pick up speed instantly.

General Electric Time Meter

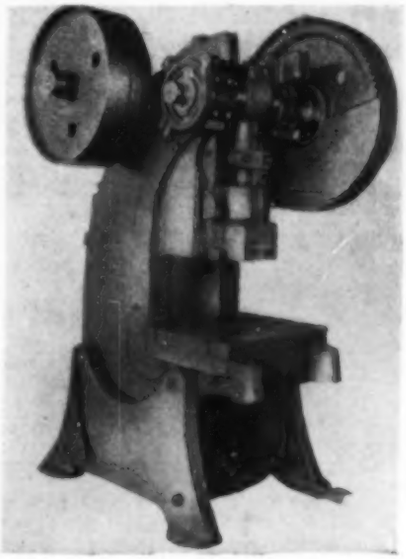
The total operating time of any electrical equipment using a.c. current is shown by a time meter introduced by the General Electric Company, Schenectady, N. Y. Within the meter is a synchronous motor, like that used in an electric clock, and operates while the circuit of the equipment is closed. This motor, through suitable gearing, drives a cyclometer five-digit counter arranged to read in either hours or minutes. Such a meter is especially valuable in checking piecerate operation, particularly when idle-time credit is allowed in computing wages. The device can also be used for making life tests of equipment and length of time automatic equipment is in operation.

The meter is supplied on a pedestal

for portable use, or with a threaded connection for permanent mounting on conduit. It is available for 110, 220 or 440 volts, and for 25, 50 or 60 cycles.

Federal No. 6 Inclinable Presses

Inclinable presses of both the flywheel and geared types are available from the Federal Press Company, Elkhart, Ind. The No. 6 press has a capacity of 65 tons and weighs 9,000

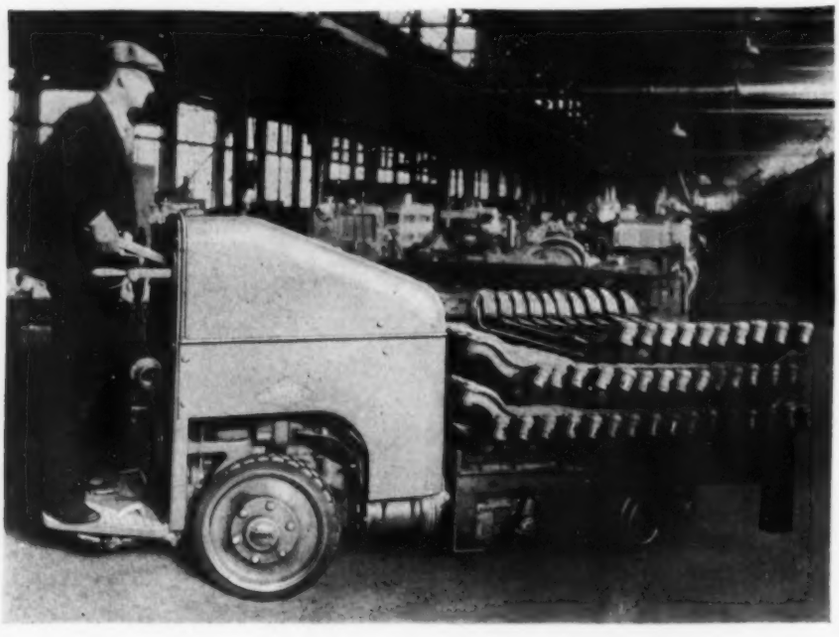


lb. in the flywheel type and 11,300 lb. in the back-geared type. Both machines are equipped with a reclining bracket which operates from the front of the press and is removable, leaving the floor space clear for tote boxes. The patented non-repeat tripping mechanism is included as standard equipment.

Timken roller bearings are now used in the mounting of the back-shaft on the geared presses. This mounting eliminates misalignment of the back-gear mechanism, since the brackets are cast integral with the frame and are bored at the same time as the main bearings.

"Truclift" Lifting-Type Power Trucks

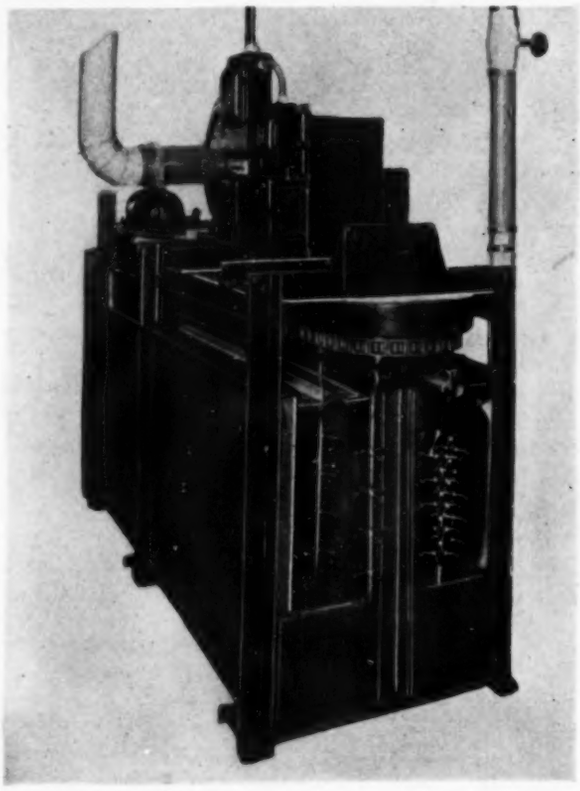
A lifting-type power truck in 3- and 4-ton models has been developed by the Clark Trucktractor Company, Battle Creek, Mich. The truck can be turned to a sharp angle to permit entering a freight car and spotting the load at the far end. A locomotive-type cast-steel frame, full-floating rear axle, hydraulic lifting mechanism with automatic control and a tractor-type gas engine are features. The 3-ton truck has a narrow platform to accommodate U. S. standard 12-in., under-clearance skid platforms. This truck has a turning radius of 94 in. The heavier model lifts 4 tons in eight seconds and turns on a 94-in. radius also.



"Metalwash" Overhead-Return-Conveyor Drying Machine

Automatic drying of metal parts coming from cold or hot rinse tanks is taken care of in the low-heat continuous drying machine announced by the Metalwash Machinery Company, Inc., 117-119 East 24th St., New York, N. Y. This machine replaces sawdust drying and is a small compact unit, arranged in two drying chambers for either hot or combination cold and hot blast drying. It is particularly suitable for use in plating rooms and finishing departments where floor space is at a premium. It is built in sizes to conform with individual production requirements. Other advantages are: The drying method prevents tarnishing of the material; the metal parts can be handled immediately after leaving the dryer; there is no steam exhaust or gas fumes, and last, should the operator leave the machine the work travels through the dryer again without harm.

The overhead, single-chain, return conveyor, which is mounted on top of the blast chambers, carries the work through the blast tunnels, entering at the left and returning at the right. The tunnels are formed by U-shaped blast chambers containing steam-radiating fin coils. An exhauster of suitable capacity creates a certain pressure in the blast chambers, which

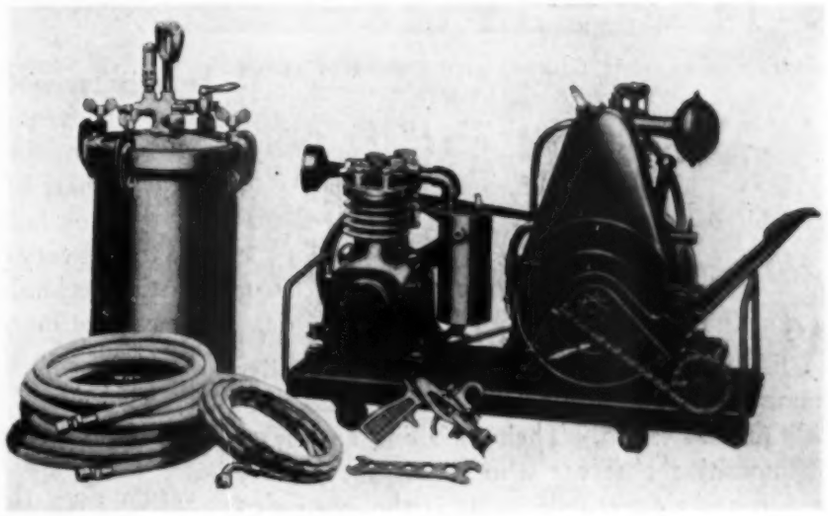


forces the hot air through the patented adjustable nozzles against the work. The water globules are blown off and the remaining moisture is evaporated by the heat. In order to eliminate water spots on highly polished material, the heat in the left-hand chamber may be reduced to prevent actual drying, but permitting the cold blast to drive off excess liquid until the work has reached the heated return tunnel, where the remaining moisture is evaporated.

The blast chambers are constructed of $\frac{1}{8}$-in. sheet steel welded air-tight and reinforced by structural steel members. The chambers are insulated with armored 1-in. asbestos lining, and flexible baffles are arranged to reduce the necessary entrance opening to a minimum. The conveying chain travels on rollers on tracks and is connected to a speed reducer.

DeVilbiss Light-Duty Gas-Engine-Driven Spray-Painting Outfit

For spray-painting and spray-finishing operations at points where electrical current is not available, The DeVilbiss Company, Toledo, Ohio, has developed a light-duty, gas-engine-driven outfit. This outfit can be carried by one person or placed in an automobile for transportation. It consists of one spray gun with adjustable spray head and wrench, 20-ft. of 5/16-in. air hose and connections, 12-ft. of ¼-in. braid-covered hose and connections, 12-ft. of 5/16-in. fluid hose and connections, a 2-gal. paint tank, and a ½-hp. gas-engine-driven compressing equipment mounted on a hand truck.



PATENTS

JUNE 16, 1931

Metal-Working Machinery

Machine Tool for Grinding. Harold E. Martin, North Providence, R. I., assigned to Brown & Sharpe Manufacturing Co. Patent 1,809,858.

Method and Apparatus for Finishing Round Bars. George A. Wise, Pittsburgh, Pa., assigned to Sutton Engineering Co. Patent 1,809,880.

Machine Tool Coolant Pan. Gustaf David Sundstrand, Rockford, Ill., assigned to Sundstrand Machine Tool Co. Patent 1,809,949.

Casting Machine. Max O. Held, Milwaukee, Wis. Patent 1,810,173.

Electric Arc Welding Plant. Romeo Jose Musto, London, England, assigned to The Quasi-Arc Co., Limited, London, England. Patent 1,810,251.

Multiple Spindle Chucking Machine. Joseph John Spring, New Britain, Conn., assigned to The Goss & Deleeuw Machine Co. Patent 1,810,300.

Apparatus for Making Castings. James H. Williams, Providence, R. I., assigned to Detroit Security Trust Co. Patent 1,810,509.

Drop Hammer. John Niver Scism, Hartford, Conn. Patents 1,810,536 and 1,810,537.

Press. Arthur A. Byerlein, Detroit, Mich., assigned to General Machinery Corporation. Patent 1,810,640.

Metal Sawing Machine with Arcuate Cut. Jules Babin and Achille Pays, Paris, France. Patent 1,810,746.

Differential Gear. George H. Benzon, Jr., Jenkintown, Pa., assigned to William Sellers & Co. Patent 1,810,747.

Tools and Attachments

Apparatus for Trimming Body Panels. Otto J. Groehn, Grosse Pointe Park, Mich., assigned to Hudson Motor Car Co. Patent 1,809,843.

Apparatus for Shaping Sheet Metal. Otto J. Groehn, Grosse Pointe, Mich., assigned to Hudson Motor Car Co. Patent 1,809,844.

Gear Shaper Cutter and Method of Making Same. Oliver G. Simmons, Lakewood, Ohio. Patents 1,809,868 and 1,809,869.

Die for Die Casting and Method of Making the Same. Victor L. Soderberg, Detroit, Mich. Patent 1,809,872.

Helical Bladed Reamer. William J. Kattrein and Frederick W. Becker, Albany, N. Y., assigned to Watervliet Tool Co., Inc. Patent 1,809,975.

Material Feeding Device. Joseph Everett Lodge, Maywood, Ill., assigned to Western Electric Co. Patent 1,809,983.

Circle Hole Cutter. Edwin C. Swanson, Rockford, Ill., assigned to Greenlee Bros. & Co., Rockford, Ill. Patent 1,809,993.

Adjustable Gage. Keith F. Gallimore, Fond du Lac, Wis., assigned to The Heald Machine Co. Patent 1,810,166.

Electric Tool for Marking. Robert L. Hinds, Toledo, Ohio. Patent 1,810,212.

Striping Tool. Herbert O'Connell, Syracuse, N. Y., assigned to H. H. Franklin Manufacturing Co. Patent 1,810,221.

Chaser and Chaser Holder. Charles P. Harrison, Wesleyville, Pa., assigned to Jarechi Manufacturing Co. Patent 1,810,241.

Reamer. Lawrence O. Beard, Lancaster, Pa. Patent 1,810,263.

Device for Bending Tubes. George A. Bryan, Peru, Ind., assigned to Bryan Steam Corporation. Patent 1,810,340.

Machine for Crimping Pipe Sleeves. Arthur J. Bulger, Brooklyn, N. Y., assigned to Pierce Steel Pipe Corporation. Patent 1,810,342.

Guard for Presses. Clinton E. Marshall, Brooklyn, N. Y. Patent 1,810,364.

Truing and Positioning Device for Grinding Wheels. Charles H. Schurr, Cleveland, Ohio, assigned to The Lees-Bradner Co. Patent 1,810,408.

Floating Reamer Holder. George H. Thomas, Erie, Pa., assigned to American Sterilizer Co. Patent 1,810,503.

Motor Mounting for Drop Hammer. John N. Scism, Wilkinsburg, Pa. Patent 1,810,538.

Gage. Carl Edvard Johansson, Detroit, Mich. Patent 1,810,710.

Processes

Process of Electrodepositing Chromium. Walter S. Bohlman, Atlantic City, N. J., assigned to Chromium Corporation of America. Patent 1,809,826.

Method of Manufacturing Bearings. William J. Fiegel and Frederick C. Jones, Detroit, Mich., assigned to Bohn Aluminum & Brass Corporation. Patent 1,809,838.

Method of Producing Gears. Bernard Edward Shlesinger, Irondequoit, N. Y., assigned to The Gleason Works. Patent 1,809,948.

Method of Arc Welding. Howard J. Burnish, Milwaukee, Wis., assigned to A. O. Smith Corporation. Patent 1,810,005.

Process for Welding Metal Tubing. Ernest Riemenschneider, Cleveland, Ohio, assigned to The Midland Steel Products Co. Patent 1,810,112.

Process of Making Molded Articles. Hermann Buchholz, Berlin, Germany, assigned to W. D. Grote. Patent 1,810,126.

Method of and Apparatus for Welding. Emerson Pugh, Chicago, Ill., assigned to Western Electric Co. Patent 1,810,225.

Method of Plating Metals. William E. Watkins, New York, N. Y., assigned to Copper Plate Sheet & Tube Co. Patent 1,810,409.

Process for the Heat-Treatment of Steel. Walter M. Cross, Kansas City, Mo., assigned to Lord Southborough, London, England. Patent 1,810,696.

Furnaces

Method of Controlling Combustion in Metallurgical and Glass Furnaces. George R. McDermott, Chicago, Ill. Patent 1,810,776.

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The Slavery of Tradition

AGAIN and again, in her fascinating book on life in equatorial Africa, Dr. Janet Miller comments on the abject slavery of the natives to tradition and taboo. Their unfailing answer to the inquisitive observer who wonders why they cling to archaic methods is "It is the custom of our tribe." Speaking of their crude agriculture she says, "Noah told his son Ham how to plow with a sharpened stick, and Ham told it to his sons, who transmitted it to their descendants, so the lineal descendants of Ham are plowing today with a sharpened stick in Central Africa."

Incomprehensible perhaps, to the white races, but then comes a news item from Spain which says that the new government will solve the farm labor unemployment problem by prohibiting the use of any kind of machinery on farms. Are we whites so free from the slavery of tradition?

A Great Foundryman

SELDOM does a living generation recognize its great men. Only a very few names ever go down into history as "great" out of the number who do excellent work, and it usually takes the next generation to recognize first-rate excellence. While they are alive such men seem to remain flesh and blood like the rest of us, and we permit their small errors to obscure their great works. But at the A.S.T.M. meeting in Chicago a permanent record has been made of the outstanding work done for the iron casting industry by the late Richard Moldenke.

The Society has recorded that "Mr. Moldenke's wealth of general knowledge of foundry technology was rivaled by none . . . In his many writings he has left us a rich heritage of facts, painstakingly garnered, and couched in language of extraordinary beauty and clarity."

The record might easily have gone further. Richard Moldenke was a man of extraordinary simplicity, with none of the rabid perverseness that so frequently characterizes the "genius." But in his field he was nevertheless a genius, and a great part of the advance that has come about in the iron industry in one form or another can be traced very closely to him. For a century iron casting technology was very nearly dormant, and it was not mere coincidence that during his years of service on the A.S.T.M. committee, his years of unassuming missionary work, and his progressive consulting practice, the whole industry was being completely revamped. The theoretical assumptions that he made years ago in relation to structure and strength of cast iron and the then discredited "semi-steel" have been proved in the actual commercial castings of today. His name will live in engineering history.

The First in History

IN conferences on management problems the large plants have held the stage partly because of their necessarily greater attention to management and partly because of their sheer size. This has undoubtedly worked hardships on executives of smaller plants who have not always been able to gain practical assistance in the solving of their own peculiar problems. Since fewer than four per cent of American manufacturing establishments employ more than two hundred and fifty wage earners, the number of executives of smaller plants is legion.

It is to be hoped that they have noted August 10, 1931 on their calendars, for on that day, at Lake George, New York, begins the first convention of smaller industries in industrial history. Such a convention is a logical and natural step, worthy of fullest support and success. The National Industrial Conference Board is again to be congratulated on its initiative and foresight.

THOSE who recall the discussions regarding accident compensation cannot help finding a similarity of thought and language regarding pensions and unemployment. The pioneers in accident prevention work are coming to the fore in the newer problems that are confronting management.

NEWS OF THE WEEK

A. J. Scaife Nominated For S.A.E. Presidency

A. J. Scaife

WHITE SULPHUR SPRINGS, W. Va., June 18—Arthur J. Scaife of the White Motor Car Co. has been nominated for president of the Society of Automotive Engineers, which is holding its summer meeting here this week. Vice-presidential nominees are: William B. Stout of the Stout Engineering Laboratories, representing aircraft engineering; Charles L. Lawrance, president of the Lawrance Engineering & Research Corporation, aircraft engine engineering; Alfred J. Poole, of the United American Bosch Corporation, Diesel engine engineering; B. B. Bachman, Auto Car Company, motor-truck and motor-coach engineering; D. G. Roos, chief engineer Studebaker Engineering Corporation, passenger car engineering; Adrian J. Noorken, Hupp Motor Car Corporation, passenger-car body engineering; A. S. McArthur, general superintendent of the Toronto Transportation Commission, transportation and maintenance engineering; J. E. Padgett of the Spicer Manufacturing Co., production engineering. The three new councilors will be: H. T. Woolson, chief engineer of the Chrysler Corporation; R. D. Wilson, director of the Standard Oil Co. of Indiana; and S. O. White, chief engineer of the Warner Gear Co. The three which will hold over for another year are: F. S. Duesenberg, Norman G. Shidle, and C. E. Tilston. Other members are G. W. Spicer, Edward P. Warner, Vincent Bendix and John A. C. Warner.

Radical changes in the design of passenger cars, involving both body and chassis are anticipated and have been widely discussed at the meeting. Not a few engineers are of the opinion that engines are likely to be shifted from the front to the rear end of the chassis in future cars, and that, whether this occurs or not, there will be marked changes in body design to give the vehicle as a whole a better streamline form with lower wind resistance, to improve riding qualities and to encourage the sale of new cars by making them much different in appearance from current models.

It has been predicted also that axles may be abandoned in favor of designs with wheels that are sprung independently, that the engine itself is likely to undergo radical changes to make it lighter, cheaper and more compact, and finally that cooling systems, fuel feeds, lubricating devices and many other parts of the car will see marked revision. Suggestions that many of the same type of radical change be incorporated in bus as well as in private car chasses have met with general approval by bus designers who have attended the sessions.

Such changes are not expected within the next year or two, but are attracting so much favorable comment that their arrival in the not distant future seems to be assured. Naturally changes of this nature are likely to involve a corresponding change in production equipment.

More likely in the near future are changes involving less departure from conventional construction, such as improved frames and a better coordination of frame with body, as research has proved that weight can be lowered materially and riding qualities can be bettered by following such a course.

Although the registration for the meeting this year is not much over 500, as against a considerably larger attendance in several past years, nearly all prominent companies are well represented and there is the usual representation from most of the smaller companies as well as from Government Bureaus. Afternoons are being given over to recreation, as in the past, but most of the technical sessions, held morning and afternoon, have been well attended.

Speculation as to what Ford and Chevrolet are likely to do in the way of changes in the near future has subsided somewhat because of the belief that no radical changes are likely in either product in the near future because of present business conditions. Ford is expected to increase the length of the Model A chassis and to make some improvements in its four-cylinder engine, but beyond this, little immediate change is expected, although both Ford and Chevrolet are said to have eights in contemplation. That Ford has been looking ahead is indicated by the paper on the "Tear-Drop Car" by Walter T. Fishleigh, a former Ford engineer, based, it is believed, upon information released by Ford and resulting from wind-tunnel tests made by Ford engineers on radically streamlined cars.

Having released this information, it is considered improbable that Ford will use a design similar to that disclosed in the Fishleigh paper, but it is a good indication of the interest being displayed in cars with lowered wind resistance.

By far the largest and most interesting session held thus far is that at which the Fishleigh paper and another by James E. Hale of the Firestone Tire & Rubber Co. on driving high-speed cars were presented. It is generally agreed that driving at speeds of sixty miles or more will become much more common in the future and that cars must be built that will be more efficient and handle better at high speed. A. M. Wolf thinks this is likely to result in cars driving on all four wheels.

Dampers for reducing the torsional vibration of Diesel engine crakshafts were discussed at the Diesel engine session, and it was shown that devices of this kind have proved very necessary on self-ignition engines in which the maximum pressures are very high. Dampers that make use of fluid friction were said to have proved highly successful, although for the smaller sizes of automotive Diesel engines the mechanical friction type is most used.

Promising suggestions for the improvement of bus chassis and bodies were made by D. A. Smith of the Detroit Department of Street Railways. They involved such radical departures as (1) the use of either horizontal-opposed or radial-cylinder engines, possibly of the Diesel type, mounted below the floor of the bus, (2) of marked changes in gearsets or their elimination, (3) of steam heating and of improved exhaust arrangements, and (4) several other innovations.

Effort to improve the riding qualities of private cars have been mentioned in the discussion as well as in the text of several papers, and are considered so important that much research is being carried out with a view to improving features of design that affect riding comfort. Some engineers feel that engines as now developed are well in advance of the remainder of the chassis and that there is greater need for development of other chassis units than for further engine improvements at this time. Much work is being done also toward coordinating body and chassis design, partly to avoid body troubles and partly in the belief that general performance of the car as well as riding comfort will be improved thereby.

Among the cars being informally exhibited here is one twelve-cylinder model fitted with an improved form of steam cooling system and another having vacuum-operated brakes and clutch.

Machine Tool Orders Show May Decline

Gross machine tool orders for May declined from 105.1 in April to 87.2, according to the latest report of the National Machine Tool Builders' Association. The three-months' average, however, increased from 102.1 in April to 103.3 in May. Shipments increased from 91.3 to 95.6 and the index of unfilled orders decreased from 238.0 to 231.9. Cancellations in May were about twice as heavy as in April, cutting down new orders received about 3 per cent. The index for Class A plants (base more than $50,000) declined from 97.7 to 81.4, that for Class B plants (base $10,000 to $50,000) declined from 130.3 to 104.5, while that for Class C plants (base less than $10,000) increased from 95.0 to 105.7. The base in each case is the average shipments for the years 1922-24.

A.S.S.T. Announces Metal Congress Papers

Sixty-five technical papers are on the tentative program of the annual convention of the A.S.S.T. which will be a part of the National Metal Congress and Exposition in Boston, Sept. 21-25. This is more than a 50 per cent increase over the number presented at the Metal Congress held last fall in Chicago. The variety of subjects covered by the papers is correspondingly widened, according to Ray T. Bayless, assistant secretary in charge of technical activities.

Separate sessions devoted to melting, sheet steel and nitriding are on the program, while the metallurgy of cast iron and non-ferrous metals will also be covered. Morning sessions of the Congress will be held at the Hotel Statler. Commonwealth Pier, scene of the National Metal Exposition, will accommodate the sessions scheduled for afternoon.

Machine Design Course Offered by Brown

To extend the work given in its Apprentice Course to drafting apprentices, Brown & Sharpe Manufacturing Co., Providence, R. I., suggested, some two years ago, to the Engineering Department of Brown University, that a special course in machine design be included with the various extension courses offered by the university. As a result, a two-year course in machine design was laid out from a purely analytical standpoint so that only analytical problems were considered and all of these problems were given from the standpoint of machine tool practice. The course was made available to men having the required preliminary work whether or not they were employees of Brown & Sharpe. Brown & Sharpe, however, reimbursed its employees who took the course to the extent of half of the tuition. The results were highly satisfactory and are now offered as a suggestion for other companies in other districts by that company.

M.I.T. Establishes Business Fellowships

Six fellowships carrying stipends of $1,500 each have been established in the Department of Business and Engineering Administration of the Massachusetts Institute of Technology. They aim to qualify technically trained men of exceptional ability for early advancement to high administrative positions and are sponsored by six business and industrial leaders, including Lammot du Pont, Alfred P. Sloan, Jr., John R. Macomber, Francis Wright Fabyan, Charles A. Stone and Charles Hayden. The purpose of the fellowships is to make it possible for a small group of carefully selected young men to develop natural qualities of leadership, vision and sound judgment by special professional training. After they enter the business field they will make a report of self development each year for five years.

THE main collection in the Engineering Societies Library comprised, on June 1, 141,546 books and pamphlets, according to a report by Harrison W. Craver, the director. During the first five months of 1931, 4,880 books and pamphlets were either purchased or received as gifts.

Industries Make Fine Safety Showing

America's industrial establishments claimed fewer accidental deaths and injuries than any other single classification last year, according to the National Safety Council.

"Accident Facts," a booklet published annually containing the first accurate findings about accidents for the previous year, shows that only 19,000 of the 99,000 total accidental deaths last year were chargeable to industry. In addition, there were some 2,500,000 non-fatal injuries. The direct costs of accidents to industry were about $850,000,000. The 19,000 figure includes every line of industry. Manufacturing plants, strictly speaking, accounted for only about 3,000 of the fatalities and a proportionate number of the injuries. Industrial fatalities have shown substantial decreases during recent years.

STANDARD dimensions, tolerances and specifications for vulcanized fiber, sheets, tubes, rods and rolls are given in a revised pamphlet just issued by the National Electrical Manufacturers Association. Specifications give standard values for mechanical and dielectric strength, specific gravity, hardness and water absorption and the methods to be used in testing. This pamphlet supersedes the third edition issued in January, 1930. It contains several new rules on tolerances for diameters of vulcanized figer tubing and rods, standard length of sheets, and minimum dielectric strength for thin-weight, fiber and fish paper.

Employees who have been with the Duriron Co., Dayton, Ohio, since its founding in 1915, recently raised the flag on the memorial flagpole dedicated to Pierce Davies Schenck, founder. Wm. E. Hall, now president, gave the dedication address, Robert C. Schenck, secretary and son of the founder, made the acceptance, and Charles Sheeley, shop foreman, gave a company history

Germany Refuses Russia Price Reduction; Orders Given to Czechoslovakia

By Our Berlin Correspondent

FURTHER price reductions on the German-Russian orders mentioned previously (*AM*—page 814, Vol. 74), which total approximately $150,000,000 to $160,000,000, have been asked by the Russian Board of Trade. German manufacturers could not grant such reductions, so Russia has placed an order for about $15,000,000 with a Czechoslovakian iron-working firm. Further, it is said that Russia is intending to establish a permanent trade representation in Prague, in order to do more business with the Czechoslovakian companies.

In the last few years, Southeast European countries have displayed remarkable activity in their mercantile policy. Afflicted, in general, by the business depression, and, in particular, by the effects of the agricultural crisis, they are endeavoring to bring about a mitigation of their unpleasant position by means of closer economic cooperation with other European countries, especially with Germany.

The economic position of the Southeast European countries has by far been over-estimated, and this over-rating was even more increased by the discussions about the plan of a German-Austrian customs union, in which the importance of Southeast Europe in economic and commercial aspects seemed far greater than it actually is.

An exhibition of the exports of the German machine industry, one of the representative German export industries, gives sufficient evidence for restricting the often rather hazy representations of the importance of the Balkan market. The accompanying survey may serve to exhibit this more explicitly.

By these figures it is shown clearly that only in a few branches the Balkan market is of any special importance to the German machine exports, and even then only in single circumstances. On the whole, the German machine exports to the Southeast European countries have shown a falling tendency for the past three years. This decrease expressed in direct figures was even surpassed by the decrease in the percentage share of the exports to all these countries which in 1928 took 15.9 per cent of German machine exports, as against 12.5 per cent in 1930.

On the part of the Southeast European countries, the development of the German machine imports reflects the impossibility of carrying through, under less favorable economic conditions, the rate of industrialization begun in the last few years. This state of affairs is the outcome of the agricultural crisis which has struck the Southeast and which expresses itself by the specially restricted purchasing of agricultural machinery. As the buying power of these countries is largely decided by the position of the agriculture, the marketing conditions for industrial products have become far worse, thereby limiting the further industrialization. It is not surprising that the interruption in industrialization becomes most acutely perceptible in those branches of industry that have already been relatively well developed. This pertains especially to the textile industry of those countries.

Although developments in Southeast Europe should by no means be overestimated for the near future, still the German-Austrian customs union is due a certain significance with regard to the economic problems on the Balkan. The export trade to the Balkan calls for a thorough knowledge of the business methods practiced there, and also of the special requirements of these countries. No doubt for the German machine industry there are advantages to be derived from the intervention of Austria, a country which for a long time has been closely tied up with the Balkans, not only in economic but also in political respects. Cooperation with Austria is in keeping with the measures, recognizable all over the world, aiming at an improvement of the relations within territories of supplemental economic interests, such as for instance may be observed in the relations of the United States to the Central and South American countries.

TABLE I—GERMANY'S MACHINE EXPORTS TO SOUTHEAST EUROPE, 1927 TO 1930

		In 1,000 dollars								
Kind of Machinery	Year	Total*	Austria	Czecho-Slovakia	Hungary	Roumania*	Jugoslavia*	Bulgaria	Total of These Countries	In Per Cent
Textile machines	1927	38,400	1,570	2,085	1,593	1,302	721	379	7,650	19.9
	1928	48,400	1,863	3,614	1,260	1,448	808	511	9,504	19.7
	1929	60,400	1,840	4,176	1,250	1,020	1,694	635	10,615	17.6
	1930	41,250	1,323	1,788	1,292	834	1,242	81	6,560	15.9
Locomotives and tenders	1927	8,450	12	14	.....	1,733	463	....	2,222	26.3
	1928	5,440	42	36	.....	33	59	2	172	3.2
	1929	5,960	21	18	.....	36	65	7	147	2.5
	1930	13,830	29	42	7	3,388	3,565	186	7,217	52.1
Machine tools	1927	32,300	884	1,290	352	569	837	101	4,033	12.5
	1928	39,200	1,476	3,600	447	1,087	914	115	7,639	19.5
	1929	50,300	1,639	3,360	574	589	1,113	207	7,482	14.9
	1930	54,000	1,160	2,445	560	514	541	112	5,332	9.9
Agricultural machinery	1927	8,180	177	266	125	184	111	88	951	11.6
	1928	8,200	260	342	184	244	123	150	1,303	15.9
	1929	11,100	353	390	112	429	281	256	1,821	16.4
	1930	9,390	423	268	43	176	172	52	1,134	12.1
Other machinery (except electrical)	1927	95,300	3,354	3,418	1,356	2,766	1,746	510	13,150	13.8
	1928	120,700	4,272	4,765	1,565	3,292	2,921	626	17,441	14.4
	1939	146,900	4,351	5,885	1,304	3,308	2,893	828	18,569	12.6
	1930	158,600	3,602	4,655	863	2,364	3,465	388	15,337	9.7
Boilers, machine parts and accessories	1927	40,600	1,440	1,533	631	1,385	705	155	5,849	14.4
	1928	50,350	1,885	2,225	758	1,520	729	189	7,306	14.6
	1929	57,600	1,795	2,510	637	1,546	748	258	7,494	13.0
	1930	58,350	1,439	2,280	420	1,209	837	160	6,345	10.9
Total	1927	223,230	7,437	8,606	4,057	7,939	4,583	1,233	33,855	15.1
	1928	272,290	9,798	14,582	4,214	7,624	5,554	1,593	43,365	15.9
	1929	332,260	9,999	16,339	3,877	6,928	6,794	2,191	46,128	13.9
	1930	335,420	7,976	11,478	3,185	8,485	9,822	979	41,925	12.5

*Including reparations deliveries in goods.

TABLE II—SINGLE ITEMS OF THE GERMAN MACHINE EXPORTS SOUTHWEST EUROPE

	Diesel Motors		Metal Working Machines		Wood Working Machines		Threshing Machines		Hydraulic Machines (Pumps, etc.)		Leather Working Machines	
In 1,000 dollars	1930	1927	1930	1927	1930	1927	1930	1927	1930	1927	1930	1927
Bulgaria	116	163	74	86	30	13	23	44	31	26	5	17
Jugoslavia	65	242	337	703	181	123	27	76	185	41	75	59
Austria	102	207	921	685	207	176	47	10	193	194	18	115
Roumania	435	620	440	420	47	127	37	33	179	116	51	60
Czecho-Slovakia	118	157	2,120	1,065	283	200	64	20	303	168	89	380
Hungary	...	50	507	206	47	141	5	...	56	76	7	45
Total	836	1,439	4,399	3,165	795	780	203	183	947	621	245	676
In per cent of the total exports	10	13	9.2	11.4	16.5	21.3	25	12.1	9.8	12.5	23.6	22.1

BUSINESS ITEMS

The Weston Electrical Instrument Corporation has acquired the Jewell Electrical Instrument Co., Chicago, Ill. Jewell was organized in 1903. The acquisition will give greater range to the products and service of Weston and will afford additional distributing facilities, especially in the Middle West. Jewel activities will be conducted by a newly organized subsidiary, Jewell Electrical Instrument Co., which will continue manufacture at the Chicago plant under the old management and without substantial changes in the personnel. Orval Simpson has become chairman of the board, and Ray R. Simpson president of the new company.

Lukenweld, Inc., a division of the Lukens Steel Co., Coatesville, Pa., has appointed W. P. McDonough & Co. representative in the Cleveland district and the Dravo Doyle Co. representative in the Pittsburgh territory.

The Hupp Motor Car Corporation opened on June 9 its Windsor, Ont., manufacturing plant, consisting of two main buildings one story high, having 30,000 sq.ft. of floor space.

The Pine Tree Die Co., Auburn, Me., has taken over the Warren S. Longmore Die Co., Stoneham, Mass., and will move the business to Auburn.

The Harrison-Smith Distributing Co. storage battery plant at 600 West Noble Ave., Oklahoma City, Okla., has been purchased by the U. S. L. Storage Battery Co., Niagara Falls, N. Y. Output of the plant will be tripled.

The Rockbestos Products Corporation, New Haven, Conn., manufacturer of electrical appliances, has completed negotiations for the opening of a Canadian branch, and will establish a plant at Montreal in conjunction with that of the E. F. Phillips Electrical Works, Ltd., of which the new firm will be a subsidiary.

The Geiger Iron Works, Inc., Stockton, Calif., has appointed the Concrete Machinery & Supply Co., Los Angeles, as dealer for southern California, Arizona and part of Nevada. Feenaughty Machinery Co., Portland, Ore., was appointed dealer for the Geiger Iron Works in Oregon, Washington and Idaho.

Sales of Ohmer cash registers, according to H. B. Ohmer, vice-president of the Ohmer Fare Register Co., during the first five months of 1931 more than doubled the volume of sales for the same period in 1930.

The N. Y., N. H. & H. R.R. Co., New Haven, Conn., closed its shops at Readville, Mass., and New Haven, June 9, laying off 1,250 men until July 7. The procedure was taken as an economic measure, and because the road has a surplus of cars in good order.

The Hill-Clutch Machine & Foundry Co., has acquired the Cleveland Knife & Forge Co. The former produces power transmission machinery, special machinery, castings, etc., while the latter makes shear blades, knives, bits, etc. The business of the two companies will be consolidated in the plant of Hill-Clutch at 6400 Breakwater Ave. The Cleveland Knife plant, 1960 West 114th St., will be offered for sale. Names of both companies will be continued for the present. Ralph Perkins, president of Hill-Clutch, will head the consolidated companies and A. C. McDaniel, head of the Cleveland Knife, will be vice-president and general manager. H. S. Donaldson will be vice-president, John R. Short, secretary and M. G. Firestone, treasurer of the combined companies.

The Polymet Manufacturing Corporation, New York City, has established Polymet of Canada, Ltd., with headquarters at Hamilton, Ont. Financing and organization details have been completed and machinery is being installed in the converted Sanford Building, corner of Catherine & Jackson Sts., Hamilton. The company will manufacture various radio products. N. C. Greene, president of the American organization, is vice-president of the Canadian unit.

The Vandyck-Churchill Co., 52 Vesey St., New York, N. Y., has been appointed representative on Porter-Cable lathes and milling attachments by the Porter-Cable Machine Co., Syracuse, N. Y. The appointment covers the New York and New Haven offices.

The Tindolph Co., 2301 Fifth Ave., Seattle, Wash., has received the Seattle agency of the Standard Conveyor Co., North St. Paul, Minn., for gravity, spiral and power conveyors and pneumatic tube systems.

The Iron Fireman Manufacturing Co., Inc., Portland, Oregon, has leased space in a factory building at 18 Beverley St., Toronto. The Canadian company, on completion of alterations and installation of equipment, will go into production.

The Union Metal Works, Inc., manufacturer of plumbing supplies, Chelsea, Mass., has purchased patterns, stock and equipment of Hamlin & Emery Brass Co., Boston, Mass., manufacturer of brass pipe fittings.

All Boston branch sales offices and warehouses of the Armstrong Cork Co., have been consolidated at 286 Congress St.

Frederic E. Starrett of Woonsocket, R. I., has been appointed permanent receiver of the Simplex Tool Co., Woonsocket, R. I.

The Hansen Engineering & Machinery Co., Inc., 676 Washington St., Lynn, Mass., has begun operations.

The Olympic Foundry Co., Seattle, Wash., has added a second story to the 60x30 addition announced recently.

The Pittsburgh (Pa.) Auto Spring Co. has been appointed distributor of the Cleveland Pneumatic Tool Co.'s automotive products in the Pittsburgh area.

PERSONALS

H. P. Anderson has been appointed chief engineer in charge of all engineering inspecting, testing and development activities of the Standard Stoker Co., Erie, Pa. He will have offices in Erie and New York.

R. D. Bean, formerly manager of the Engineering Development Department of the Brown Instrument Co., Philadelphia, has been made chief engineer.

Frank K. Billett, for the past eight years head of the Cost Accounting Department, has been appointed secretary of the Toledo (Ohio) Scale Co. He has been connected with the company for more than ten years.

J. H. Birdsong, metallurgist of Pratt & Letchworth, Inc., Buffalo, has been elected chairman, Buffalo chapter, A.S.S.T.

Edwin A. Carter, vice-president of the Chapman Valve Manufacturing Co., Springfield, Mass., has been elected to the newly created office of chairman of the board of directors. Thomas F. Mahar, sales manager, has been chosen vice-president.

H. G. Chase has been appointed sales manager of the Standard Alloy Co., Cleveland, Ohio. He was formerly identified with General Alloys Corporation, Boston.

R. M. Doull, formerly on the engineering staff of the Dominion Engineering Works, Ltd., Lachine, Que., is now connected with the Construction Equipment Co., Montreal.

F. F. Elliott has been appointed mill and foundry general superintendent of the Westinghouse Electric & Manufacturing Co., taking charge of the brass foundry, copper mill and Trafford (Pa.) foundry operations. H. F. Seifert has been appointed superintendent of the brass foundry and copper mill. C. R. Stevens has been made purchasing engineer of the purchasing department.

John R. Freeman, civil and mechanical engineer of Providence, R. I., and past president of the A.S.M.E., was awarded an honorary degree of Doctor of Science at the annual commencement of Yale University.

Charles E. Gross, recently general superintendent of the South Side Works, A. M. Byers Co., Pittsburgh, Pa., has been appointed general superintendent of the new plant at Ambridge, Pa. He has been succeeded at Pittsburgh by Amos Kamerer, formerly pipe mill superintendent.

A. D. Lynch, personnel director of the Ohio Brass Co., Mansfield, has been elected president of the National Association of Foremen, to succeed W. J. Donkel of the Kent-Owens Machine Co. Edward Miller and J. Kesselmire were made vice-presidents.

Fred Grotts has joined the Continental Roll & Steel Foundry Co., East Chicago, Ind., as metallurgical engineer with headquarters there. He will direct metallurgical activities of the Hubbard Steel Foundry division, East Chicago, Wheeling Mold & Foundry division, Wheeling, W. Va., and Duquesne Steel Foundry division, Coraopolis, Pa. He was previously superintendent of wheels, American Steel Foundries.

Dr. Edouard Houdremont, chief superintendent of the Krupp Works, Essen, Germany, is visiting the United States and is making his headquarters at the offices of the Krupp Nirosta Co., Inc., 230 Park Ave., New York, N. Y.

James A. Ireland has been appointed central district sales manager for Steel & Tubes, Inc., Cleveland. He will be assisted by J. J. I. Jamieson and J. A. Upstill.

W. C. Mander, for many years associated with the Nordyke & Marmon Co., Indianapolis, as chief engineer, has been appointed sales and milling engineer for the flour mill machinery department, Allis-Chalmers Manufacturing Co., to succeed the late James Forrest.

Thomas H. Morcom, assistant superintendent of the General Railway Signal Co., Rochester, N. Y., has been appointed factory superintendent succeeding the late Frank H. Banner. He has

been with the General Railway Signal Co., for the past 12 years in the positions of assistant production manager and assistant superintendent. He will be succeeded as assistant superintendent by Robert H. Parks, who has been with the company for some time.

Henry W. Phelps, president of the American Can Co., New York; W. E. Taylor, general manager; K. S. Breckenridge, vice-president, and other officials attended the formal opening of the new plant of the company at Terre Haute, Ind., on June 5.

William H. Rohrbach has been appointed purchasing agent of the Motor Accessories Co., Allentown, Pa.

John L. F. Ross has joined the engineering staff of the Ajax Manufacturing Co., Euclid, Ohio.

Alvan T. Simonds, president of the Simonds Saw & Steel Co., Fitchburg, Mass., received the honorary degree of doctor of science, at the recent annual commencement of Boston University.

C. L. Saunders, general advertising manager and purchasing agent of the Morse Chain Co., Ithaca, N. Y., recently merged with the Borg-Warner Corporation, Chicago, Ill., has retired. He will take an extended vacation and then resume his work as consulting, merchandising and purchasing engineer, specializing on reports on mechanization.

H. S. Simpson of the National Engineering Co., Chicago, has been elected president of the Foundry Equipment Manufacturers' Association. J. P. Jones of the General Electric Co., Schenectady, has been elected vice-president. These officers, with H. S. Hersey of the C. O. Bartlett & Snow Co., Cleveland, M. C. Sammons of the Wadsworth Core Machine & Equipment Co., Akron, and H. J. Koch of the Fort Pitt Steel Castings Co., McKeesport, Pa., compose the board of directors. R. P. Dryer, secretary-treasurer of the association, resigned to devote his entire time to the Steel Office Furniture Institute, and D. M. Avey, of *The Foundry*, Cleveland, was elected secretary-treasurer.

Ben Sloan, Pratt & Whitney Co. representative in New Jersey, sailed June 13 with the A.S.M.E. party for a joint meeting with the German Engineering Society (Verein Deutsche Ingenieure). Mr. Sloan will also visit England, France, Italy and Switzerland.

Morris Taylor, of the Lincoln Electric Co., Cleveland, is going to Japan to confer with officials of the Japanese government on problems in connection with all-welded construction of battleships for the Imperial Japanese navy. He will also lend technical assistance to the welding of a large steel pipe line being fabricated by Kawasaki & Co., Tokio, for the city's water system.

Max Toby, for some time a member of the engineering department of the Pacific Electric Manufacturing Corporation, San Francisco, has been made advertising manager. He succeeds Ralph Whalley, who has been assigned to sales work in the San Francisco district.

Daniel E. Weedon has been appointed treasurer and general manager of the Russell Manufacturing Co., Middletown, Conn., to succeed William C. Fisher, who retired June 1 after 50 years' service. Mr. Fisher becomes vice-president in an advisory capacity.

OBITUARIES

Frank H. Banner, factory superintendent of the General Railway Signal Co., Rochester, N. Y., for the past eight years, died May 22, after an illness of several months.

Charles H. Dickey, 72, long proprietor of the Maryland Meter Works, Baltimore, and former president of the American Meter Co., died suddenly of a heart attack June 17.

Jno. E. Graybill, president and general manager of the York (Pa.) Electric & Machine Co., died there June 16.

John A. Howard, 59, who retired a year ago after many years as chief engineer of the American Radiator Co., New York, died recently in Buffalo, following a short illness.

Charles T. Hummel, 65, superintendent of the G. A. Gray Co., Cincinnati, Ohio, for 49 years, died June 14.

Lloyd Johnson, 50, manufacturing director of the Joubert & Goslin Machine Co., Birmingham, Ala., died recently.

Charles J. Ketcham, purchasing agent of Jenkins Bros., Bridgeport, Conn., died June 8.

F. G. Kretschmer, 70, who opened the Brown & Sharpe Manufacturing Co. office in New York in 1893, and later representative of several American machine tool firms in Germany, died in Frankfort-am-Main June 15.

Joseph J. Kwis, 74, president and general manager of the Model Foundry & Machine Co., Findlay, Ohio, with which he had been identified for 40 years, died recently at Cleveland.

Howard J. Mehl, 43, traffic manager of the Diamond Chain & Manufacturing Co., Indianapolis, died recently there from a heart attack. He had been with the company for 25 years.

F. H. Satterlee, president of the F. E. Satterlee Co., Minneapolis, Minn., machine tool dealers, died there June 12.

Frank E. Stevens, 69, president and founder of Lattimer-Stevens Co., Columbus, Ohio, manufacturer of gas appliances, died June 13 there.

Arthur Stewart, 56, purchasing agent of the Continental Can Co., died recently in Wheeling, W. Va., following a brief illness.

Henry W. Wilkening, 68, director of the Cincinnati Ball Crank Co., Cincinnati, Ohio, died June 9 there.

FORTHCOMING MEETINGS

THE INDUSTRIAL INSTITUTE—Silver Bay on Lake George, N. Y., August 10-25. Charles R. Towson, secretary, 347 Madison Ave., New York, N. Y.

NATIONAL METAL CONGRESS AND EXPOSITION — Exposition on Commonwealth Pier, and Congress sessions at Hotel Statler, Boston, Mass., week of Sept. 21. Information from W. H. Eisenman, Secretary A.S.S.T., 7016 Euclid Ave., Cleveland, Ohio.

SOCIETY OF AUTOMOTIVE ENGINEERS —National Production meeting, Detroit, Mich., Oct. 7-8. Headquarters, 29 West 39th St., New York, N. Y.

NATIONAL SAFETY COUNCIL — 20th Annual Safety Congress, Chicago, Oct. 12-16. Civic Opera Bldg., Chicago.

SOCIETY OF AUTOMOTIVE ENGINEERS —National Transportation meeting, Washington, D. C., Nov. 10-12. Headquarters, 29 West 39th St., N. Y. C.

THE INDUSTRIAL REVIEW

Weekly progress of the machinery and machine tool business

NEW YORK

Most tool dealer interest is centered now on the Brooklyn Navy Yard inquiry for 17 engine lathes, upon which bids were closed Tuesday. The order is estimated to run somewhere between $50,000 and $60,000. Other inquiries include one for several lathes for use aboard battleships and one from the Lighthouse Department for three 13-in. and a 16-in. lathe. In most cases, little change occurred from last week, only one dealer noting an improvement. The summer is expected to remain quiet, but the "if the business situation—" clause is always added.

DETROIT

Large automobile manufacturers are planning radical changes in design. Many comprehensive changes are under way. That the fall will bring forth significant developments, with attendant development in the machinery field, seems likely.

June is even worse than May, which was discouraging. Many large motor car and accessory plants have sharply curtailed production. The general lack of confidence is if anything accentuated. In the face of this gloomy situation there are many bright prospects for the fall, and dealers are actually making plans for increased business. There are many uncertain factors, however, and the favorable predictions have so often failed to materialize that even the most optimistic observers are maintaining a conservative attitude.

SOUTHERN DISTRICT

New developments are lacking in the machinery and machine-tool market, resulting in a continued sluggishness that has been evident the past sixty days. Sales are for the most part concentrated about small tool business and little movement in the used tool market is reported. Railroad and industrial inquiry has been insignificant, and in the instance of the former there has been practically no orders of which to speak.

Prices were reported to be slightly below their normal levels. Jobbers have been issuing lists with greater frequency than during early months of the year, and judging from offerings there are larger stocks in hands of most of the important houses. All principal points are slow in so far as machinery and tool sales were concerned. Road equipment has been on the upgrade.

CANADA

Machinery and machine tool markets in Canada continue to expand in keeping with the steady improvement in industrial conditions. The features of the metal-working situation are the maintenance of a fair degree of activity in the iron and steel industry; the extensive mining and water-power developments which are calling for a large amount of machinery, and the growing demand for all kinds of construction machinery, resulting from the extensive new building and road-making work being carried out in several provinces. The new steel tariff provisions have been favorably received by leaders in that industry, and it has been estimated that Canadian plants will be enabled to turn out another $50,000,000 worth of iron and steel products. The major agricultural implement lines give no indications of improved conditions, but there is a decided betterment in the automotive trade, with weekly increases being reported in the demand for parts and accessories. Inquiries for used tools are fairly numerous. Another encouraging feature is a turn for the better in lumbering conditions, particularly in British Columbia, with a consequent increase in the demand for saw-mill machinery. The employment situation generally at the end of May was the most satisfactory since the beginning of the year.

SUMMER sluggishness, known in years gone by, coupled with business slackness, still a surprise in some circles, combine to create a machinery and machine tool market showing little change from week to week. New tools that sell are those for urgent replacement; used tools are hard to dispose of even at greatly reduced prices. There have been, however, but few evidences of price cutting, and prices are expected to hold their present level until general business again turns upward. Business men are expecting big things to result from Hoover's reparations plan.

NEW YORK is awaiting the award of the lathes for the Navy Yard, and has a few other inquiries, mostly governmental, with which to occupy its spare moments. Industrial demand continues negligible there and in Detroit, where hope is based largely on the possibility of radical model changes for fall and a consequent upturn in tool demand resulting from the need for new dies. Canadian markets continue to improve, with automotive and used tool demand up. Southern District markets, on the contrary, continue slow, with sales principally of small tools. New England's sales are also principally of small tools, although some foreign inquiries and a domestic inquiry for two radials have just been released.

CHICAGO expects fall improvement, but has nothing to offer now. San Francisco business is spotty, some dealers having almost normal sales, others being 'way off. Indianapolis inquiries are up slightly, though sales are still largely special equipment to sand and gravel, road, crushed rock, radio, and refrigerator industries. Cincinnati has little to add, except a hope that things will go no lower.

NEW ENGLAND

The first half of June is now over and probably shows arrears as far as the machine tool industry is concerned. The sales volume from week to week, while substantially even, continues far below normal, taking the seasonal dull period into consideration. Small tools hold better promise than other lines due to schedule pickups in several New England centers. Cities in scattered districts plan equipping metal- and wood-working departments for school purposes and orders are expected shortly from these sources. New foreign inquiries were circulated recently, and two domestic inquiries for radial drills were reported. Outside of these few instances and the booking of an order for a $67,000 Diesel engine, the week was extremely dull. No amount of pressure seems capable of breaking down the sales resistance built up by ultra-extreme economic measures.

CHICAGO

No change in machine tool market conditions has developed within the last week. Continued dullness characterizes the situation, with inquiries sporadic and sales few. It seems to be the general opinion, as expressed by manufacturers' representatives and distributors, that business in shop equipment requirements is destined to remain at its present low level for an indefinite period, no improvement being looked for during the midsummer period. The situation would not seem so depressing, dealers and selling agents say, were there any definite signs pointing to a general trend toward resumption of industrial acivities within a measurable period, but as none can be discerned at this time they can only continue to hope that recession has reached its lowest point.

SAN FRANCISCO

No important developments feature the Pacific Northwest market. Business continues spotty. Some houses report almost a normal volume while others are behind last year's levels. Curtailment of logging, lumbering and canning to between 40 and 50 per cent of normal is keenly felt by machine tool and shop equipment houses. Activity in public works construction is the only bright spot, lettings of contracts by federal and state governments for highway and road work being exceptionally heavy. General industrial operations are at a low ebb, and tool demand from that source is limited. Small machine shops are short of work. Demand for compressors, drills, pneumatic track tools and road equipment has been fairly good. Houses manufacturing accessories for airplane construction are quite busy, but automotive tool houses report small turnover. No important inquiries have developed recently, although the Hoover dam project and the Great Northern railroad extension into California have brought some business to the Northwest. The Navy Department has awarded contracts for lathe, shaper and milling machinery to Seattle houses for the Sand Point aviation field. Seattle is in the market for motor-driven lathe, shaper, drill and other equipment for the Diablo hydro-electric power plant.

INDIANAPOLIS

Some slight increase in inquiries is seen, but sales of all equipment are difficult. It seems that those industries that should be taking the bulk of machinery now are virtually down and have curtailed buying to absolute necessities. Ohio Valley general shipments are up.

Still some demand comes from the crushed rock, sand and gravel and cement industries. This buying is mostly done, however, for this year, though some scattered orders are being placed for special equipment. There is some continued demand from the radio and refrigerator industries of the state. Some orders for miscellaneous machine tools are being picked up from machine shops and some special equipment is being sold to garages.

CINCINNATI

With flat tires and a low gas supply, the business car is creeping along as best it can, the driver hoping to get to a prosperity service station. Machine tool manufacturers have little or no expectation of making a gain in the next three months, which even in normal times is a dull period, and the best that is hoped is that there will be no further recession. The major portion of the orders booked were from the smaller users, located in all sections of the country, these including general machinists and industrial concerns, whose requirements, as a rule, were single tools and replacements. A fair volume of inquiries were received.

BUSINESS • BAROMETER

The conspicuous increase in gold reserves is a moral guarantee of cheap money for a long time to come

THEODORE H. PRICE
Editor, Commerce and Finance, New York

DURING the last two weeks the Federal Reserve Banks have increased their gold reserves by at least $65,000,000. This increase is due to the release of "ear-marked" gold held by the Federal Reserve Banks for account of foreign banks or bankers, and the importation of at least $7,500,000 of gold from Canada. Part of the gold thus made available is said to have been re-purchased for foreign account, but it has been difficult to get the exact facts, and no one is as yet quite certain where all this gold came from or why it should be sent to the United States, which does not need it. It is variously attributed to the German Reichsbank, the Bank of France, and the State Bank of Holland, all of whom are said to be playing a part in helping Germany to meet her reparations payments, and lending a hand in extricating the Kredit Anstalt of Vienna from the difficulties with which it has been struggling for the last two or three weeks.

These details are not, however, directly important to the business men of the United States. The important thing is that this conspicuous and enormous increase in our gold reserves is a moral guarantee of cheap money for a long time into the future. As this is a condition that has never failed to advance prices in the past, it is difficult to see why it should not have that effect in the near future.

Meantime there is a slight but distinct improvement in business, and most close observers are commencing to feel a little more optimistic with regard to the future.

An investment trust to buy commodities is being talked of, and some of the staples that are dealt in for future delivery are a little higher, and somewhat more active than they have been for months.

The speech delivered by President Hoover at Marion, Ohio, is regarded as a declaration of his intention to run again, and for that reason his views with regard to the early return of American prosperity have attracted wide attention.

On the Stock Exchange prices for high grade bonds have advanced. Industrial stocks are only slightly lower, but the railroad shares are singing something that sounds like a recessional, as the action of the Interstate Commerce Commission upon the advance in rates that has been asked for is awaited. Bankers and insurance companies, as well as the railway officials themselves, seem to be very confident that the Commission will allow the advance in rates. It is, however, unlikely that such an advance will be granted without giving those who represent the shippers and the public a hearing, and delay in such matters often proves disheartening.

Amongst wholesale distributors and retail dealers a more confident feeling is to be discerned, and experienced merchants express themselves as well satisfied with the outlook.

The steel industry is said to be cheerful despite the fact that operations have been reduced further. Sheet mills are trying to establish new base prices for third quarter business, involving increases of $5 a ton on black sheets, $3 on galvanized and $2 on automobile body sheets. Resistance may be encountered. Definite information with regard to the automobile trade is hard to obtain, but those dealers who are candid admit that the demand has not been quite as large as they hoped and expected it would be.

Copper is in good demand, but it has not been able to advance, and those who know the facts insist that the demand depends upon a revival of business activity.

Opinions differ as to whether such a revival impends. In some sections, including certain portions of New York, there is more building than has been seen for months, but the foreclosure of some of the real estate mortgages by which outstanding bond issues are secured is causing great distress and resentment among small investors. This is a feature of the situation, and one concerning which it seems to be very difficult to get definite information.

Trading in silver on the National Metal Exchange commenced June 15. Since then there has been a fair degree of activity, but prices have not yet changed much, and it seems unlikely that there will be any marked advance or decline until after it is decided whether an international conference on the silver question shall be held. Such a conference seems to be highly desirable, and many prominent authorities on both sides of the Atlantic are urging that it shall be immediately convened. If it is held and the value of silver as a medium of exchange is recognized, the effect upon Oriental trade would be electrifying.

That our own export business needs stimulation is definitely indicated by our export trade in May. It reached a new low level of $205,000,000, or a drop of nearly $10,000,000 from the April total of $215,000,000. For the eleven months ending with May our exports were $2,897,000,000 as against $4,980,000,000 in 1929. Taken by themselves these figures provide what is almost a sufficient explanation of the present depression. Prices are now down to levels which are certain to attract the consuming public of the world if some way to pay us for what we have to sell is promptly provided.

THE BUSINESS WEEK

June 24, 1931

Summer sets in without any sign that business is going to break through the bottom on which it has been stabilizing itself for six months. . . . The seasonal let down in the general level of activity seems, on the whole, to be little, if any, more than usual so far, and in some respects slow improvement since the beginning of the year has become evident. . . . This is most marked in trade lines closest to the consumer, where low prices and accumulated attrition on the second pair of pants appear to have stimulated replacement of current requirements. . . . Merchandise carloadings, for instance, have shown a slow rise since last December, after due allowance for seasonal factors; and retail trade reports are reassuring as to volume, if not profits. . . . Check payments outside New York also show a rising trend since March; and though currency in circulation has been affected by confidence in banking conditions, the relatively high level is probably not without some trade significance. . . . Commodity prices have rallied slightly after recent sharp declines, and bond markets have made a little better showing. . . . The basic production and construction industries alone offer little encouragement for an early recovery. . . . Here the effect of continued lack of confidence, still emphasized by uncertainty about conditions abroad, is most marked. . . . Decisive action on the inevitable debt moratorium would dispel some of this paralyzing doubt.

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THE WEEKLY PRICE GUIDE . . . . SI

Rise and Fall of the Market

STEEL sheet-makers ask $1 to $5 per ton increase in prices for third-quarter business. It remains to be seen whether or not the advance will actually develop into selling prices. Iron-buying is confined to such small lots that the situation as it now exists in this trade is probably without precedent. Railroads and the construction industry are using steel in appreciable quantities but automotive requirements have taken a severe drop in the last week. The closing, until September, of two lead smelters, one in Utah and the other in Montana, may result in firmer prices. Markets for other non-ferrous metals continue to display weakness. Chicago warehouses reduced prices on bars, hoops, bands and cold-finished steel, this week, in quantities ranging from 400 to 999 lb.

(*All prices as of June* 19, 1931)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI:	
Ala. Foundry (Silicon, 1.75@2.25)	$14.19@$14.69
Tenn. Foundry (Silicon, 1.75@2.25)	14.19@ 14.69
NEW YORK:	
Buffalo No. 2 Fdry. (Silicon, 1.75@2.25)	19.91@ 20.41
BIRMINGHAM:	
No. 2 Foundry (Silicon 1.75@2.25)	12.00@13.00
PHILADELPHIA:	
Eastern Pa., No. 2x (Silicon, 2.25@2.75)	17.76
Virginia No. 2 (Silicon, 1.75@2.25)	22.29
Basic	17.00@17.25
CHICAGO:	
No. 2 Foundry, Northern (Silicon, 1.75@2.25)	17.50
No. 2 Foundry, Southern	17.01
PITTSBURGH:	
No. 2 Foundry	17.50
Basic	16.00@16.50
Bessemer	17.50

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.00
Cleveland	4.75
Cincinnati	4.40
New York	4.75
Chicago	4.50@4.75

STEEL SHEETS—Prices are in cents per lb. for sheets from warehouse stock except at Pittsburgh mill, where prices apply on large lots:

Blue Annealed*	Pittsburgh Mill	Chicago	Cleveland	New York
No. 10	1.85	3.20	3.00	3.20
No. 12	1.90	3.30	3.10	3.25
No. 14	2.00	3.40	3.20	3.30
No. 16	2.10	3.50	3.30	3.40
Black				
Nos. 18 to 20	1.95@2.05	3.35	3.40	3.30
No. 22	2.10@2.20	3.50	3.55	3.45
No. 24	2.15@2.25	3.55	3.60	3.50
No. 26	2.25@2.35	3.65	3.70	3.60
No. 28	2.40@2.50	3.80	3.85	3.75
Galvanized				
No. 10	2.05@2.10	3.40	3.20	3.35
Nos. 12 to 14	2.15@2.20	3.50	3.40	3.40
No. 16	2.25@2.30	3.60	3.50	3.50
No. 18	2.35@2.40	3.75	3.65	3.65
No. 20	2.55@2.60	3.90	3.80	3.80
No. 22	2.60@2.65	3.95	3.85	3.85
No. 24	2.75@2.80	4.10	4.00	4.00
No. 26	3.00@3.05	4.35	4.25	4.25
No. 28	3.25@3.30	4.60	4.50	4.50

*Light Plates.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. butt	56.14%	43.6%	53.3%	42.3%	57.3%	44.8%
3½ to 6 in. lap	52.72%	40.18%	50.8%	37.8%	53.9%	41.4%

List prices on which foregoing discounts apply, are as follows:

Size, Inches	List Price per Foot	—Diameter in Inches— External	Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.275	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.585	2.875	2.469	.203
3	.765	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28
8	2.50	8.625	8.071	.277

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb.:

Thickness		Outside Diameter in Inches						
		½	¾	⅞	1	1¼	1½	
Inches	B.w.g.	Price per Foot						
.035	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049	18	.17	.18	.19	.20	.21	.23	.25
.065	16	.19	.20	.21	.22	.23	.25	.27
.083	14	.20	.22	.23	.24	.25	.27	.29
.095	13	.21	.23	.25	.26	.27	.29	.31
.109	12	.22	.24	.26	.27	.28	.30	.32
.120 or .125	11	.23	.25	.27	.28	.29	.31	.33
.134	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb.:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered bessemer rods	7.00	6.00	6.15
Hoop steel	3.55	4.00	3.50
Cold rolled strip steel	4.95	6.00	5.60
Floor plates	4.65	5.00	5.00
Cold fin., round or hexagon	3.40	3.40	3.10
Cold fin., flat or square	3.90	3.90	3.60
Structural shapes	2.90	2.95	3.00
Soft steel bars and bar shapes	2.90	2.95	2.75
Soft steel bands	3.20	3.20	2.95
Rivets, structural or boiler	4.00	4.00	4.00
Tank plates	2.90	2.90	3.00
Bar iron (2.75 at mill)	2.90	3.00	2.75
Drill rod (from list)	65%	55%	60%

*Flat, $\frac{3}{16}$-in. thick by $\frac{3}{4}$-in. wide.

Electric welding wire at New York warehouse—$\frac{3}{32}$, 8.35c. per lb.; $\frac{1}{8}$, 7.85c. per lb.; $\frac{5}{32}$ to $\frac{1}{2}$, 7.35c. per lb.

METALS

Warehouse prices in cents per lb. for small lots:

Copper, electrolytic, New York			9.00
Tin, Straits, pigs, New York			24.00
Lead, pigs, E. St. Louis	3.60	New York	4.75
Zinc, slabs, E. St. Louis	3.35	New York	4.50

	New York	Cleveland	Chicago
Antimony, slabs	9.00	10.00	10.75
Copper sheets*	18.12½	18.12½	18.12½
Copper wire*	9.75	9.87½	9.87½
Copper, drawn, round*	16.62½	16.62½	16.62½
Copper tubing*	20.62½	20.62½	20.62½
Brass sheets, high*	15.50	15.50	15.50
Brass tubing, high*	20.37½	20.37½	20.37½
Brass rods, high*	13.75	13.75	13.75
Brass wire, high*	16.12½	16.12½	16.12½

*Mill, base.

SHOP MATERIALS AND SUPPLIES

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%, f.o.b.	20.00	20.00	20.00
Zinc sheets (casks)	9.00	10.50	10.50
Solder (½ and ½)	20.87½	21.50	16@18

Babbitt metal, delivered in case lots, New York, cents per lb.:

Genuine, highest grade	42.00
Commercial genuine, intermediate grade	33.25
Anti-friction metal, general service	28.00
No. 4 babbitt, f.o.b.	9.00

NICKEL AND MONEL METAL—Prices in cents per lb., base, f.o.b. Huntington, W. Va.:

	Nickel	Monel Metal
Sheets, full finished	52.00	42.00
Sheets, cold rolled	60.00	50.00
Strip, cold rolled	55.00	45.00
Rods, hot rolled	45.00	35.00
Rods, cold drawn	50.00	40.00
Tubing, seamless	75.00	65.00
Angles, hot rolled	50.00	40.00
Plates	52.00	42.00

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars:

	New York	Cleveland	Chicago
Crucible copper	6.25	6.00	5.50@ 6.00
Copper, heavy, and wire	5.75	5.75	4.75@ 5.25
Copper, light, and bottoms	4.75	5.25	4.50@ 5.00
Heavy lead	2.50	2.75	2.00@ 2.50
Lead battery plates	1.12½	1.00	1.25@ 1.50
Brass, heavy, yellow	3.00	3.75	3.00@ 3.25
Brass, heavy, red	4.75	5.50	4.25@ 5.00
Brass, light	2.00	2.25	2.50@ 2.75
No. 1 rod-brass turnings	3.50	2.75	3.00@ 3.25
Zinc	1.00	1.00	1.00

TIN PLATES—Charcoal—Bright—Per box:

"AAA" Grade:	New York	Cleveland	Chicago
IC, 14x20	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.07@$0.11	$0.13	$0.13
Cotton waste, colored, per lb.	.05½@.09	.09	.09
Wiping cloths, colored, per lb.	.10	.08	.09
Sal soda, per lb.	.01¾	.02	.02
Roll sulphur, per lb.	.028	.03	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.	.092	.099	.096
Cutting oil, about 25% lard, per gal	.65	.60	.60
Machine oil, medium-bodied, per gal	.33	.28	.21
Belting—Discounts from list:			
Leather—List price, 24c. per lin.ft., per inch of width, for single ply:			
Medium grade	30-10%	30-10%	50%
Med. grade, heavy wgt.	30%	30 -5%	40%
Rubber transmission—List price, 6-in., 6 ply, $1.83 per lin.ft.:			
First grade	60-10-10%	50-10%	60%
Second grade	70-10%	60- 5%	65%

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.029	$0.029	$0.0325
Cold fin. shafting	per lb.	.034	.034	.034
Brass rods	per lb.	.1375	.1475	.1725
Solder (½ and ½)	per lb.	.2087½	.2037½	.245
Cotton waste, white	per lb.	.07@.11	.07@.11	.13
Disks, aluminum oxide mineral, cloth, No. 1 6-in. dia.	per 100	4.36	4.36	4.59
Lard cutting oil	per gal.	.65	.75	.65
Machine oil	per gal.	.33	.35	.33
Belting, leather, medium	off list	30-10%	30-10%	30-10%
Machine bolts, up to 1x30 in., full kegs	off list	65%	65%	50-10%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper*	$6.03	$6.03	$6.03
Emery cloth*	20.31	25.87	25.87
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper†	2.61	2.61	2.61
Cloth†	4.36	4.59	4.59
Fire clay, per 100 lb. bag	1.00	.75	.75
Coke, prompt furnace, per net ton		Connellsville,	2.40
Coke, prompt foundry, per net ton		Connellsville,	3.25
White lead, dry	100 lb. kegs	New York,	13.25
White lead, in oil	100 lb. kegs	New York,	13.25
Red lead, dry	100 lb. kegs	New York,	13.25
Red lead, in oil	100 lb. kegs	New York,	14.75

*Less than 3 reams. †Less than 200.

SHOP SUPPLIES

Discounts from list, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less	65%
Larger, up to 1 x 30-in., full kegs, list less	65%
Less than full kegs or case lots, add to list	10%
Fitting-up bolts: list less	45%
Lag screws:	
Up to ½-in. x 6-in., list less	65%
Larger, list less	65%
Less than full keg or case lots, add to list	10%
Rivets:	
Structural, round head, full kegs, net	$4.00
Structural, round head, broken kegs, net	4.50
Tank, ⅜-in. dia. and smaller, list less	65%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less	65%
Larger, up to 3-in., list less	65%
Less than keg or case lots, add to list	10%
Washers:	
Wrought, full kegs, per 100 lb., list less	$4.00
Wrought, broken kegs, per 100 lb., list less	2.00
Turnbuckles:	
With stub ends, list less	20-10%
Without stub ends, list less	55%
Chain:	
Proof coil, base, per 100 lb., net	$9.50
Cast iron welding flux, per lb., net	.35
Bronzing flux, per lb., net	.50

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Equipment Wanted

Que., Montreal — Denis Tremblay, 5199 Fabre St.—complete equipment for automobile repair shop.

Opportunities for Future Business

Calif., Brea—Bd. of Education, Olinda High School District, plans a 1 story, 58 x 106 ft. vocational school, including automobile repair shop, electric shop, etc., here. Estimated cost $35,000. T. C. Kastner & Co., Architects Bldg., Los Angeles, Archts.

Calif., Los Angeles—Braun Corp., 363 New High St., manufacturers of scientific instruments and equipment, etc., awarded contract for a 2 story, 185 x 400 ft. storage and distribution plant. Estimated cost $100,000. Walker & Eisen, Western Pacific Bldg., Archts.

Conn., Bridgeport—Jenkins Bros. Inc., Water St., awarded contract for a 1 story, 40 x 65 ft. addition to factory for the manufacture of valves and kindred products. Estimated cost $35,000.

Conn., Greenwich—Conde Nast Publishing Co., Post Rd., awarded contract for the construction of a 1 story, 60 x 140 ft. electrotype building. Estimated cost $40,000. Noted June 11.

Conn., West Hartford—Smith & Jessen, Park Rd., awarded contract for a 1 story, 35 x 108 and 35 x 55 ft. shop, garage, etc. Estimated cost $40,000. Noted May 14.

Ga., Atlanta — Gaylord Container Co., 229 Grant St. S. E., plans a 1 story, 200 x 200 ft. factory for the manufacture of cardboard and paper boxes and containers. Estimated cost $85,000.

Ind., Evansville — Sunbeam Electrical Mfg. Co., is receiving bids for addition to factory on West Morgan St. Estimated cost $40,000. Private plans.

Illinois and Indiana—National Auto Haven Co., 201 North Wells St., Chicago, will not build tourist hotels, service stations, repair shops, etc. Company under investigation. Noted June 4 and 18.

Mass., Belchertown — Commonwealth of Massachusetts, Dept. of Mental Diseases, State House, Boston, is having plans prepared for the construction of an industrial buliding. Estimated cost $150,000. Kendall Taylor & Co., 209 Columbus Ave., Boston, Archts.

Mass., Cambridge (Boston P. O.)—Norwhit Co., c/o Nordblom, 18 Oliver St., Boston, awarded contract for the construction of a 4 story, 120 x 140 ft. warehouse on Northern Artery here. Estimated cost $200,000. Whitehead Metal Products Co., 69 Washington St., Boston, lessee.

Mich., St. Clair—Buhl Aircraft Co., Marysville, is having plans prepared for the construction of a 1 and 2 story airplane factory at St. Clair Airport here. Estimated cost $100,000. Private plans.

Mich., Selfridge—Constructing Quartermaster U. S. Army, will receive bids until July 7 for the construction of air corps assembly shop, warehouse and hangars.

Missouri — Missouri State Highway Department, Jefferson City, will soon award contract for the construction of thirty maintenance buildings, 1 story, 41 x 76 ft. each. Estimated total cost $150,000.

Mo., St. Louis—Doane Carton Co., 912 North Market St., will build a 1 story, 60 x 80 ft. addition to carton factory. Estimated cost $50,000. Clymonts & Heinicke, 721 Wainwright Bldg., Archts. Work will be done by separate contracts. Contract let for concrete work.

Mo., Sikeston—Missouri State Highway Commission, Jefferson City, awarded contract for the construction of a garage and division office. $62,500.

Neb., Omaha — Grant Storage Battery Co., plans to rebuild part of plant recently destroyed by fire. Estimated cost including equipment $40,000.

N. H., Milford—Souhegan Motor Co., c/o A. W. Osberg, 795 Elm St., Manchester, Archt., will receive bids until June 27 for addition to garage, 2 story, 50 x 105 ft. Estimated cost $40,000. Noted June 18.

N. J., Allwood—American Colortype Co., 207 West 25th St., New York, N. Y., will soon award contract for alterations to plant here. Estimated cost $40,000. Ballinger Co., 12th and Chestnut Sts., Philadelphia, Pa., Archt. and Engr. Contract let for road work.

N. J., East Rutherford — East Rutherford Syringe Co., 75 Mozart St., postponed construction of a 2 story, 30 x 70 ft. factory at 54 Mozart St. Estimated cost $40,000. J. T. Camlet, 26 Piaget Ave., Clifton, Archt. Maturity probably in Sept. Noted June 11.

N. Y., Brooklyn—Brooklyn Institute of Arts & Sciences, Academy of Music Bldg., plans the construction of a shop at Eastern Parkway and Washington Ave. Estimated cost $45,000. McKim, Meade & White, 101 Park Ave., New York, archts.

N. Y., Brooklyn—H. S. Burnham, 215 West 75th St., New York, N. Y., will receive bids about Nov. 1 for the construction of a 100 x 160 ft. garage and storage building at Gravesend Ave. and Ave. J. Estimated cost $40,000. W. Shary, 22 East 17th St., New York, Archt. Work will be done by general and separate contracts. Noted June 18.

N. Y., Brooklyn — P. S. Glickman, 1498 Broadway, will build a 100 x 200 ft. service garage at 23rd Ave. and 59th St. Estimated cost $40,000. H. J. Nurick, 44 Court St., Archt. Work will be done by day labor and separate contracts. Noted June 18.

N. Y., Brooklyn—H. M. Hillman, 188 Flatbush Ave. Ext., manufacturers of brass and copper products, will soon award contract for alterations to storage building at Flatbush Ave. Ext. and Myrtle Ave. Estimated cost $40,000. E. Owre, 53 Ft. Hill Circle, St. George, S. I., Archt. Noted June 4.

N. Y., Brooklyn—Rand Rubber Co., Haley St. and Sumner Ave., will soon award contract for alterations and equipment for factory. Estimated cost $40,000. M. Marlo, 200 Beverly Rd., Archt.

N. Y., Brooklyn—Thames Trading Co., 47 Thames St., is receiving bids for the construction of a 4 story, 100 x 200 ft. plant at Bogart St. and Harrison Pl. Estimated cost $250,000. S. Goldsmith, 4914 Church Ave., Archt. Noted June 18.

N. Y., Brooklyn—M. Tucker, 120 Magnolia Ave., Floral Park, will build a service garage at Crystal St. and Liberty Ave. Estimated cost $40,000. M. Hirsch, 350 Stone Ave., Archt. Work will be done by general and separate contracts. Maturity soon. Noted June 18.

N. Y., New York—Kohler & Campbell, 601 West 50th St., manufacturers of pianos, plans alterations to factory, 6 story, 100 x 125 ft. Ross & McNiel, 274 Madison Ave., Archts.

N. Y., New York—N. Libardo, 78 Woodycrest Ave., White Plains, is receiving bids for a 1 story, 100 x 107 ft. service garage at Van Nest Ave. and 178th St. here. Estimated cost $40,000. M. W. Del Gaudio, 545 5th Ave., Archt. Noted June 11.

N. Y., New York—Rockwells Bakery, 328 East 75th St., plans converting factory into service garage, 100 x 125 ft. at 439 East 75th St. Estimated cost $40,000. W. Shary, 22 East 17th St., Archt.

N. Y., New York—W. Tatt, 348 West 27th St., plans the construction of a 4 story service garage. Estimated cost $100,000. W. Shary, 22 East 17th St., Archt.

N. Y., New York—Two Thousand One Hundred Five Daly Ave. Corp., M. Savio, Pres., 1708 Lexington Ave., plans the construction of a 2 story service garage at River Ave. and McClellan St. Estimated cost $100,000. A. Lombardi, 1221 Sheridan Ave., Archt. Maturity about Jan., 1932.

N. Y., New York—Two Hundred Twenty, West Sixty First St. Corp., L. Irish, Pres., 60 West 42nd St., plans the construction of a 1 story, 100 x 250 ft. service garage at 218 West 61st St. Estimated cost $70,000. C. Schaefer, Jr., 332 East 149th St., Archt. Maturity November or later.

N. Y., New York—W. W. Westervelt, 194 Godwin Ave., Ridgewood, N. J., plans addition and alterations to 3 story, 100 x 125 ft. garage at 252 West 87th St. here. Estimated cost $45,000. LeRoy P. Ward, 205 East 42nd St., New York, Archt. Maturity about November. Noted June 11.

N. Y., Warwick—Commissioner of Social Welfare, State Office Bldg., Albany, will receive bids July 15 for the construction of twenty-five buildings and service connections at New York State Training School for Boys here.

N. Y., West Brighton—Tompkins Bus Corp., M. Gordon, 735 Richmond Rd., is having plans prepared for a 2 story garage on Castleton Ave. Estimated cost $150,000. Architect not announced.

O., Akron—Dept. of Public Service, F. E. Swineford, Dir., will soon receive bids for a group of buildings for Guggenheim Aeronautical Research Institute at municipal ariport. Estimated cost $100,000.

O., Cincinnati—Sun Oil Co., 1608 Walnut St., Philadelphia, Pa., is having plans prepared for a new bulk oil storage and distribution plant, including machine shop, etc., here. Estimated cost $400,000 including equipment.

O., Cleveland—Otis Steel Co., 3341 Jennings Rd., awarded contract for the construction of a cold steel rolling mill on Riverside St. Estimated cost $40,000.

O., Zanesville—Weller Pottery Co., awarded contract for the construction of a 1 story addition to plant No. 3 to double capacity on Ceramic Ave. Estimated cost $100,000.

Pa., Holmesburg—Dept. of Public Welfare, J. F. Dugan, Dir. City Hall Annex, Philadelphia, awarded contract for a 2 story, 62 x 430 ft. cell building and 46 x 68 ft. addition to shop for House of Correction here. Noted June 4.

Pa., Philadelphia — Boyertown Burial Case Co., E. L. Mory, Pres., 1211 Arch St., awarded contract for a 3 story, 34 x 112 ft. plant at Florist and Juniper Sts. Noted June 11.

Pa., Philadelphia — Modern Fireproof Construction, Inc., acquired a site and plans the construction of a 201 x 204 ft. plant for the manufacture of steel fireproofing products.

Tex., College Station—Texas A. & M. College, is having plans prepared for the construction of a chemistry and engineering building. Estimated total cost $550,000. F. E. Giesecke, College Station, Archts.

Va., Richmond — Virginia School Co., Marshall St. and Hermitage Rd., plans to rebuild part of plant recently destroyed by fire. Loss $80,000.

Wash., Seattle—Wire Rope Mfg. & Equipment Co., subsidiary of Puget Sound Machinery Depot, 322 First Ave., plans to rebuild plant including machine shop recently destroyed by fire. Loss $150,000.

Wis., Madison—U. S. Dept. of Agriculture, Washington, D. C., will receive bids until July 21 for the construction of a forest products plant and equipment to include shavings exhauster, vacuum pumps, boiler feed pumps, coal pulverizers, air compressors, etc., here. Estimated cost $700,000. Holabird & Root, 333 North Michigan Ave., Archts.

Ont., Toronto—Mack Trucks of Canada Ltd., A. V. Harburn, Gen. Mgr., 1933 Yonge St., plans the construction of a plant.

Ont., Toronto—Toronto Transportation Commission, F. L. Hubbard, Chn., 35 Yonge St., will soon award contract for the construction of a motor coach terminal building at Bay and Edward Sts.

AMERICAN MACHINIST

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Two $500 Cash Prizes, Medal Plaques, and Certificates of Award will be given in the *American Machinist* 1931 Awards for Most Effective Equipment Replacement Policies

All briefs must be in the hands of the Chairman of the Committee on Awards, care of *American Machinist*, McGraw-Hill Publishing Company, New York City, on or before September 1, 1931. Companies that plan to file briefs are urged to notify the Chairman of the Committee of their intentions as early as possible.

The Awards will be announced during the month of October, 1931.

Write for booklet giving complete details on these *American Machinist* Awards for most effective Equipment Replacement Policies.

American Machinist, 10th Avenue at 36th Street, New York City.

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The Johnson Friction Clutch Is Being Used As A Part Of This Machine

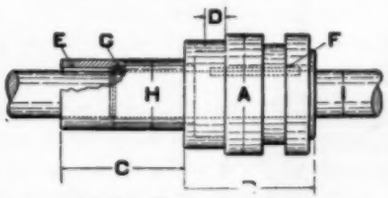
ON A **NEW SIZE**

DIE CASTING MACHINE

(12x16 inch)

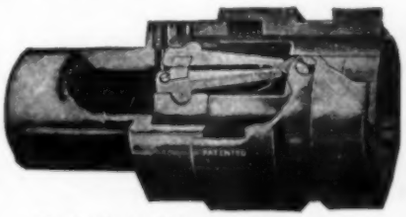
The Special No. 6 Single JOHNSON Cut-off Coupling Clutch transmits 3 Horsepower at 600 r.p.m. It connects the driving motor to the power receiving end of the machine. The JOHNSON CLUTCH can be seen at the right just above the motor. One man controls the entire machine and operates this JOHNSON CLUTCH 2000 times per day by hand lever.

Satisfied with JOHNSON CLUTCH performance on their Model DC 10 in. x 14 in. Machine, Madison-Kipp have equipped their new, more massive No. 4—12x16 in. Die Casting Machine with the JOHNSON CLUTCH also.

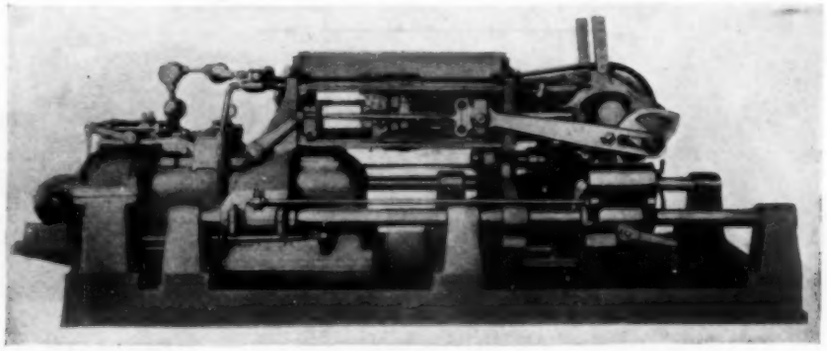


No. 6 Single Clutch made as a One-Way Cut-Off Coupling is used on this machine

Give JOHNSON CLUTCH performance a trial—use the NEW SUPER-JOHNSON for high speeds, heavy pick-up loads, where excessive slipping is encountered and for excessive engaging per hour or day.



Single Clutch Showing Working Parts



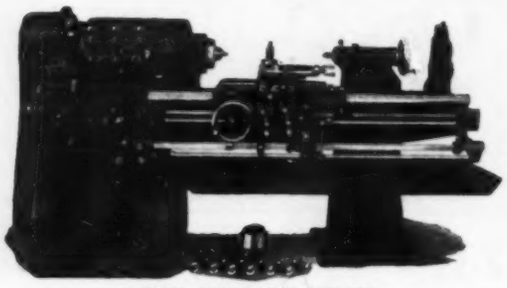
This is the No. 4—Size 12-in.x16-in.—Weight, 14000 lbs.—Length, 13 ft.—Width, 51 in.—Height, 52½ in.

SEND FOR CATALOG "BLUE-64"

THE CARLYLE JOHNSON MACHINE CO.

MANCHESTER, CONN.

LET'S



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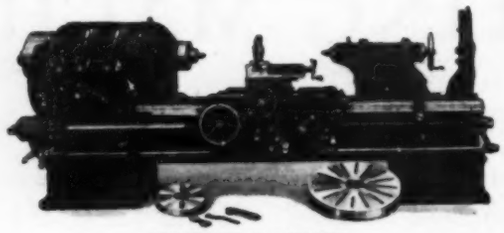
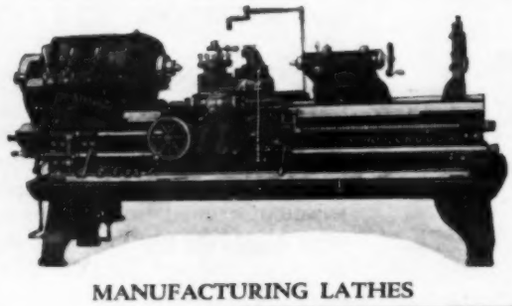
Tool room accuracy, in the most powerful 12 in. and 14 in. lathes ever built.



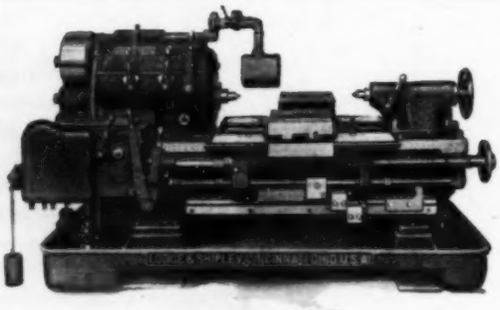
ENGINE LATHES

A lathe of accurate dependability over a wide range of lathe operations. Sizes 12 in. to 48 in.



MANUFACTURING LATHES

A versatile machine for production or single piece jobs, in sizes from 12 in. to 36 in.



DUOMATIC LATHES

A fully automatic lathe for large or small lot production.

THE LODGE & SHIPLEY
CINCINNATI,

CHECK UP

Are you familiar with this modern lathe equipment?

There are thousands of machine tools in use today which are obsolete, not because they do not retain a great degree of their original capabilities, but because new developments have made them comparatively inefficient. As the cost of labor makes it more expensive to operate inefficient machines than to buy new equipment, we say LET'S CHECK UP. Let's make sure you are acquainted with the time saving and cost reducing features of the Lodge & Shipley Line as it is today.

This check-up will take but a few moments of your time and may be the means of locating weak spots in your production line—machines that have been obsoleted by new designs with greater capacity for production over a wider range of operations.

Take, for example, the Lodge & Shipley Tool Room Lathe. This machine is entirely new in design. It incorporates features that make it the last word in tool room equipment. A 28-page booklet has just been issued describing this machine. Until you have seen it you do not know just how good a tool room lathe can be.

And how about your engine lathes? Can they take the feeds and speeds used in today's production? Or, will they waste valuable minutes when it is necessary to rush through a breakdown job while men and machines stand idle? Tell us what sizes you use and we will be glad to send you booklets of "Lathe Features" that will interest you.

There is a place in almost every production line for the Manufacturing Lathe. This machine has facilities for multiple tooling with standard lathe tools and Multiple Stops for accurately controlling lengths and diameters. Set-up is so simple that it amounts to no more than the time saved on the first few pieces, as the Manufacturing Lathe handles work at a saving of up to seventy-five per cent of the time required to machine it on an engine lathe. It is an efficient machine for production and can also be used as an engine lathe. We will be glad to tell you more about it.

If you have a production schedule of 100 piece lots or greater you should acquaint yourself with the Duomatic. It is impossible to give in a few words an idea of the possibilities of this automatic machine. However, some idea of its ability can be gained when you consider that both front and rear carriages travel in completely automatic cycles, feeding at any angle, with independent automatic control for each carriage. A booklet completely describing this machine is yours for the asking.

It is only logical to assume that your product requires the low cost production of efficient equipment, so "let's check up", let us tell you about this modern equipment, either by mailing you the booklets or through a Lodge & Shipley representative.

LATHES
Good Lathes Only

MACHINE TOOL CO.

OHIO, U. S. A.

PATENTED

One of the many installations of Cincinnati Hydromatics in leading automotive plants that out perform other milling machines. This 5-48 Plain Hydromatic form mills mild steel crankshaft counterweights from the rectangular shape. Special cutters rotating at 40 R.P.M. with a 2.5 in. average table feed (variable), give a production of 162 pieces per hour.

DEPENDABLE COUNSEL ON

REPLACEMENT paid well here

Exactly! There is real profit in proven Hydromatic performance. Replacement of a former automatic miller with this Cincinnati Hydromatic paid unusually well. Production increased 160% . . . metal removal capacity, cubic inches per horsepower increased 13.2% . . . cutter life increased 227% . . . real savings, that contributed to a 35% net return on investment. These results far exceed those obtained from obsolete equipment.

You, too, can expect to earn new profits by replacing with proven Hydromatics. There are so many new features of design, operating convenience, and flexibility, which assure you that the Hydromatic will out perform any other milling machine. Positive dog-controlled locked hydraulic table feed, automatically varied to suit the cut . . . long table bearing surface . . . powerful efficient spindle drive and rigid cutter support, brought this splendid return on investment.

Compare the features of your automatic milling machines with those of the Hydromatic. Your analysis should show you, that greater profits can be earned by replacement.

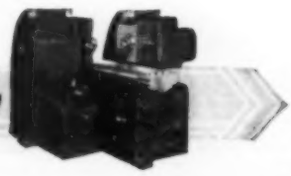
CINCINNATI

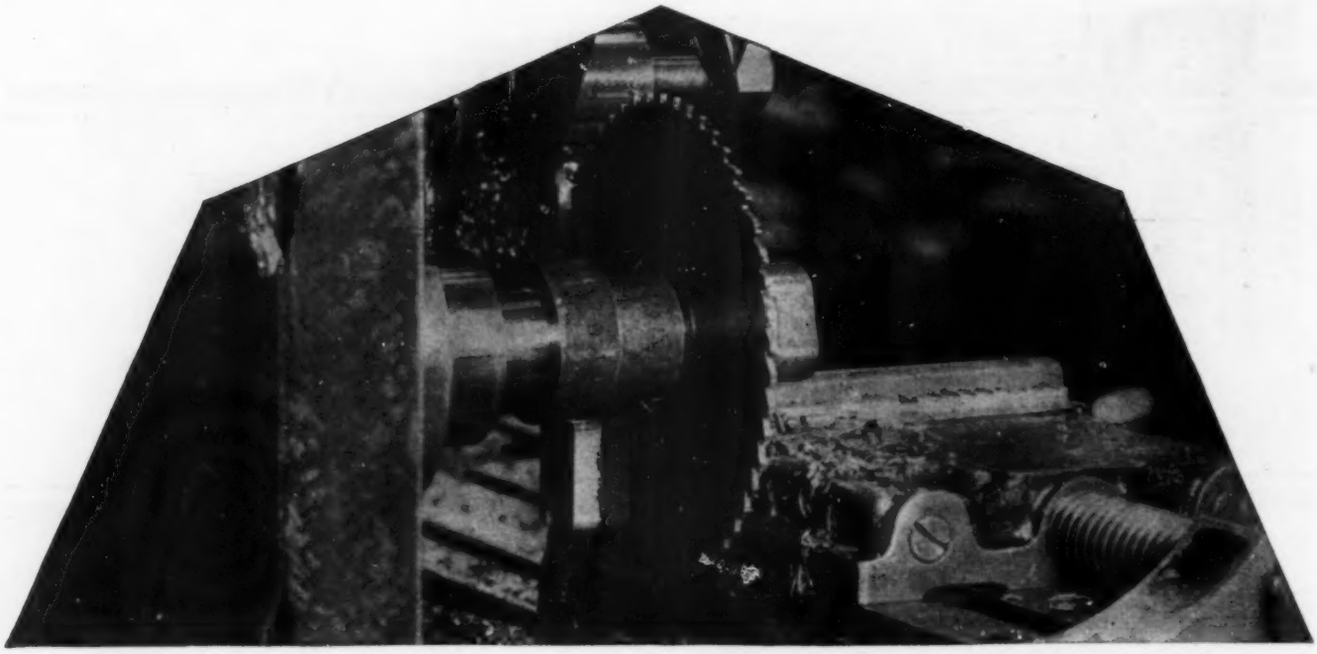
REPLACE WITH

Hundreds of Cincinnati Hydromatics are proving themselves by actual performance.

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI, OHIO, U.S.A.

MILLING AND GRINDING





BARBER-COLMAN Cutters *on the job*

They do clean, fast sawing

Barber-Colman Metal Slitting Saws do clean, fast sawing. They may be used for cutting deep slots in many kinds of metal. The 3/32" x 6" Barber-Colman Saw, pictured above, is operating at a feed of 1.125" per minute and a speed of 78 r.p.m. in S.A.E. 1035, the operation consisting of cutting off blanks used for clutch yokes.

Barber-Colman Metal Slitting Saws can be supplied with side teeth for cutting deep slots at production speeds and with radial teeth ground undercut on the sides to give proper clearance in deep slotting. The construction of both types enables the teeth to break the chips and keep them clear of the work, thus preventing any tendency to bind, while at the same time giving free cutting action.

We make Side Tooth Metal Slitting Saws to order only. They may be obtained in any desired size. Radial Tooth saws are supplied in a wide range of sizes from 1/32" x 2½" to 3/16" x 8" in either carbon or high speed steel.

We suggest you write us today regarding your special saw requirements.

BARBER-COLMAN COMPANY

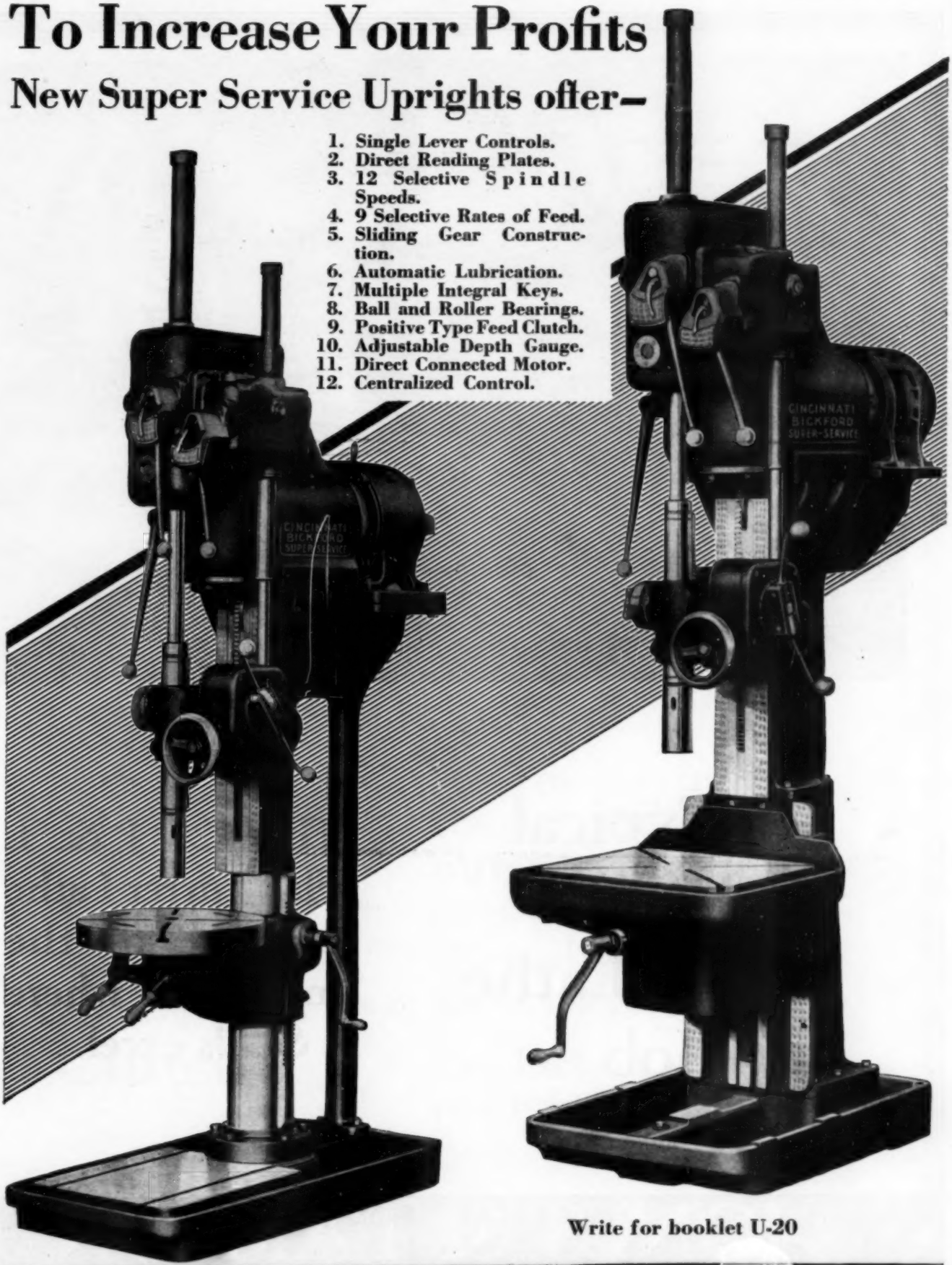
General Offices and Plant

ROCKFORD, ILLINOIS, U. S. A.

To Increase Your Profits

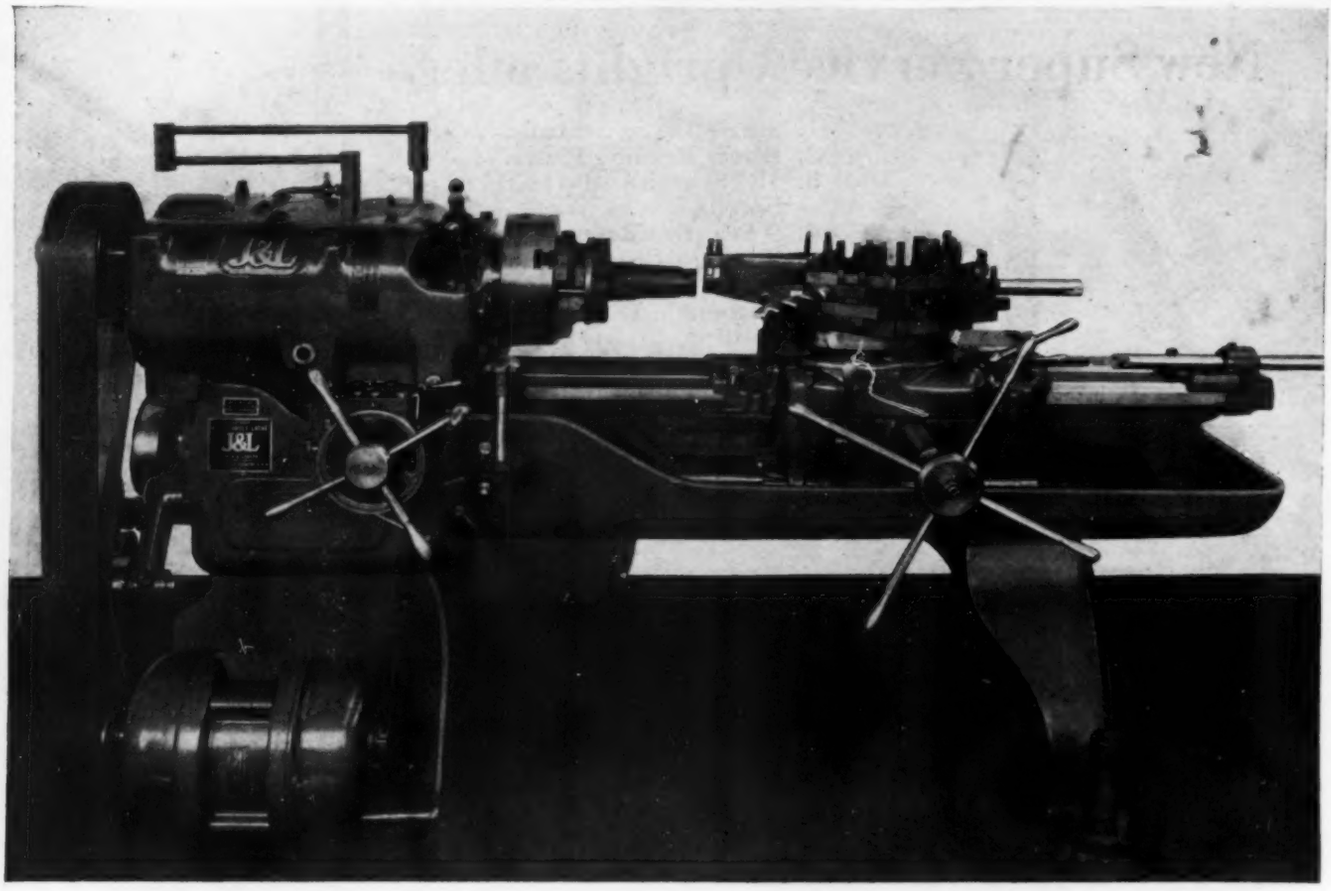
New Super Service Uprights offer—

1. Single Lever Controls.
2. Direct Reading Plates.
3. 12 Selective Spindle Speeds.
4. 9 Selective Rates of Feed.
5. Sliding Gear Construction.
6. Automatic Lubrication.
7. Multiple Integral Keys.
8. Ball and Roller Bearings.
9. Positive Type Feed Clutch.
10. Adjustable Depth Gauge.
11. Direct Connected Motor.
12. Centralized Control.



Write for booklet U-20

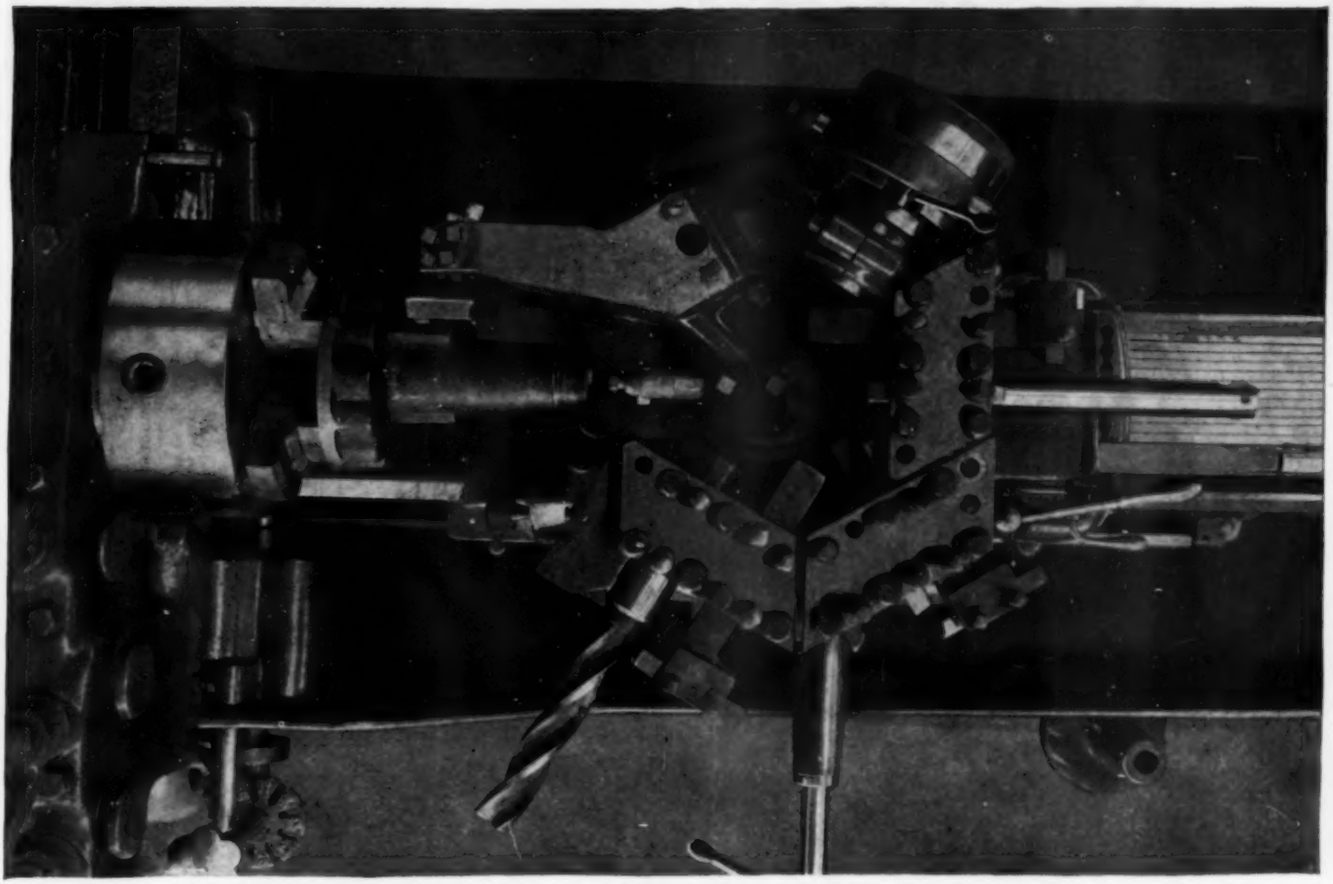
The Cincinnati Bickford Tool Company, Oakley, Cincinnati, Ohio



A Typical J & L Turret Lathe Job

The 12″ J & L Flat Turret Lathe on one of the many jobs where J & L's excel.

JONES & LAMSON
SPRINGFIELD,



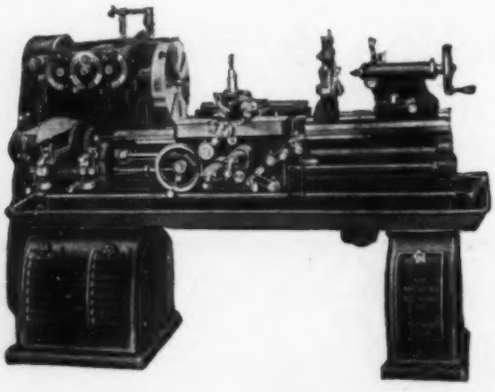
First Operation On Clutch

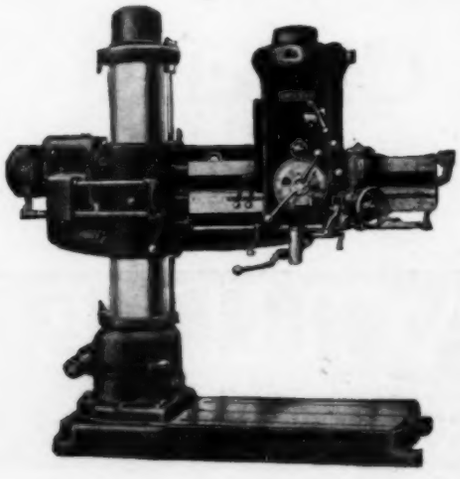
The machine roughs and finishes outside diameter, cuts neck, chamfers, threads, and core drills hole.

Production 6 pieces per hour.

MACHINE COMPANY
VERMONT, U. S. A.

Don't Let Obsolete Machin





es Steal Your Shop's Earning Power

The earning power of any shop is largely dependent upon the equipment in it. The poor performance of one machine is often responsible for the high cost of production of a piece on which there are several more operations.

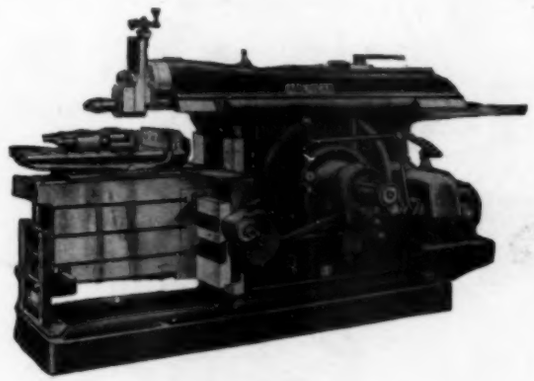
In other words the earning power of several machines is handicapped by one obsolete machine. Alert production officials are weeding out this sort of equipment and replacing it with new, sturdy, high production machines.

American Lathes, Radials and Shapers are filling such gaps in many shops—they are not only earning dividends on their own production but establishing a rate that assures a low cost production on the finished work.

It will be to your advantage to eliminate old, obsolete machines which are reducing your shop's earning power and replace them with "Americans." These husky machines have greater power, are capable of heavy cuts and are easily operated.

The American Tool Works Co.

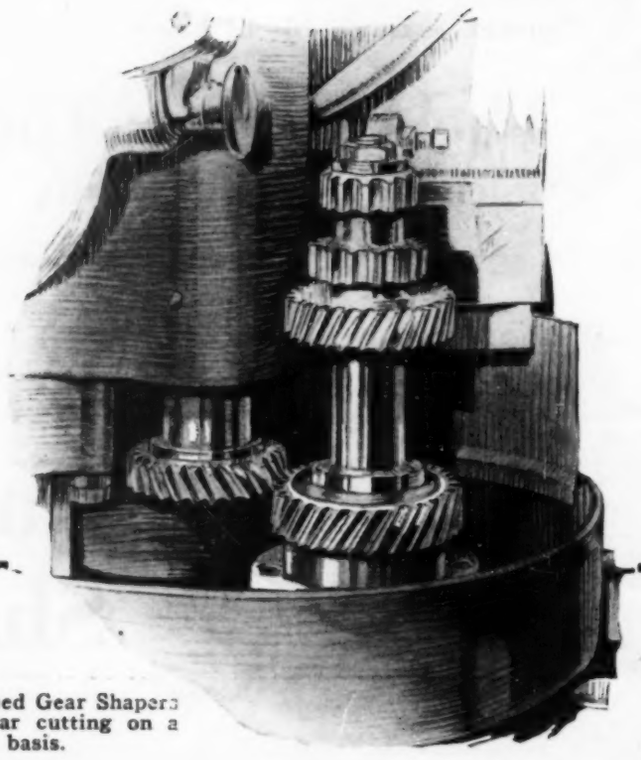
Cincinnati, Ohio, U. S. A.



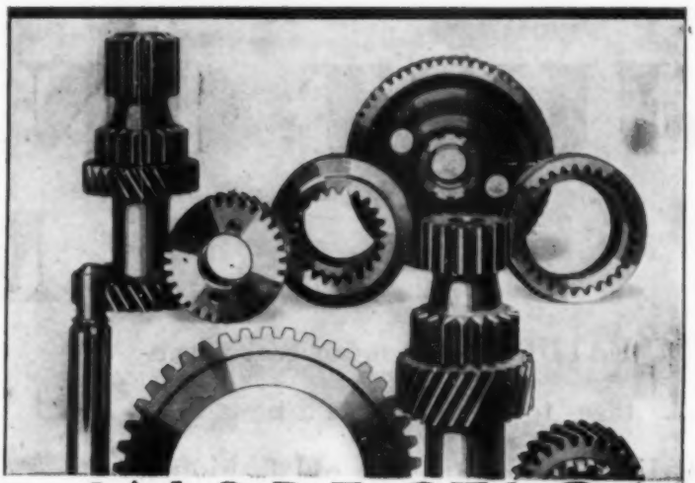
Lathes
Radials
Shapers

BEWARE OF
BLIND SPOTS
IN YOUR GEAR CUTTING

MACHINING METHOD—TOOLING



Fellows High Speed Gear Shapers will put your gear cutting on a 1931 ECONOMY basis.



—AND FINAL INSPECTION

Fellows Advantages apply in cutting spur or helical gears, internal or external—and racks, splines, ratchets, cams, etc., as well.

You have high-accuracy of gear output under **CONTROL** only so long as you can allocate responsibility. You expect—and rightfully—that the machine maker will assume his proper share, but the machine is only one factor. The tooling and inspection are also important; and a run of bad gears involves far more than the loss of blanks and gear cutting time. It ties up the entire production line while you hunt for the trouble. Just suppose you've set up a BLIND SPOT, a spot where responsibility is divided. How the dollars can leak away.

AVOID BLIND SPOTS in your gear cutting and you'll save money in the long run. Fellows Gear Shapers tooled with Original Fellows Gear Shaper Cutters produce good gears at the lowest cost per piece acceptable for assembly—of which standard of accuracy, inspection on the "Fellows Red Liner" is visual proof.

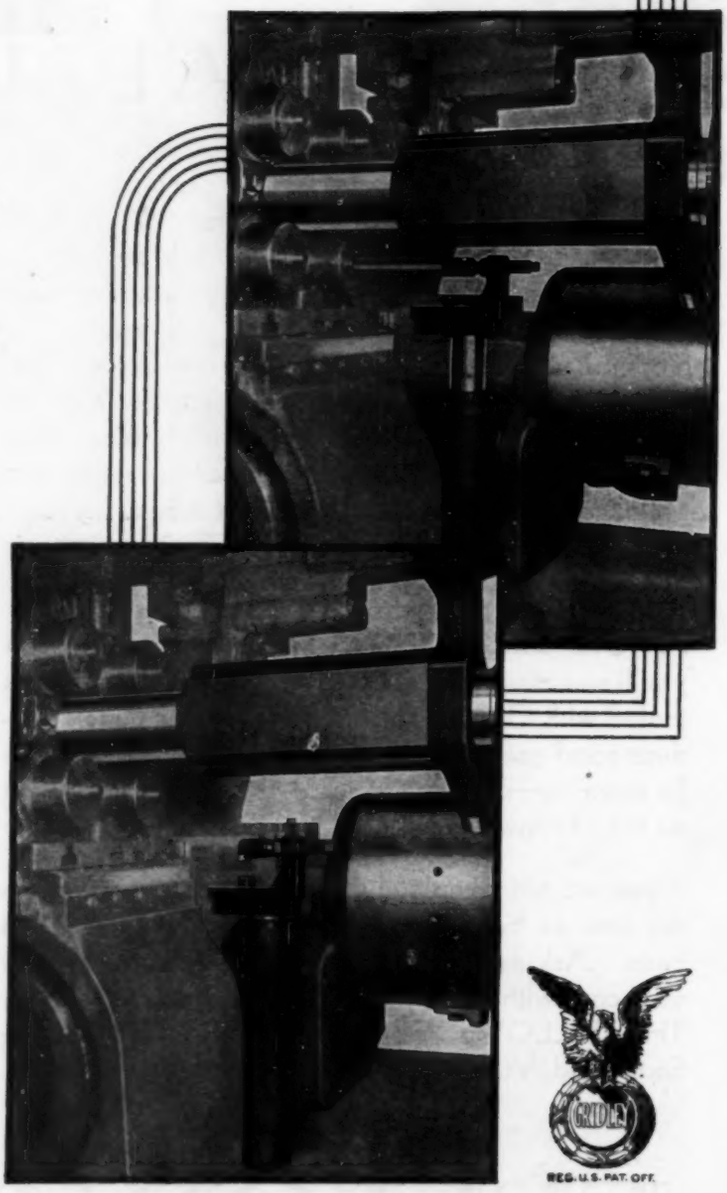
If you are not completely "Fellows" equipped, this is the time to be dissatisfied with your gear production costs. Ask us to have one of our engineers go over your costs with you. No obligation, of course, *Write:* THE FELLOWS GEAR SHAPER COMPANY, Springfield, Vt., (*or Detroit Office, 616 Fisher Bld'g*).

FELLOWS
~ GEAR SHAPERS ~

42

JUST ONE *of* MANY

FEATURES that mean real advantages to the owner of a new "GA" Gridley Automatic. The old fashioned swinging stock stop has now been superseded by the vertical disappearing stock stop. This arrangement permits tooling in the fourth position with standard tool holders, thereby adding one spindle to the useful productive capacity of the machine. The design of the stock stop also prevents chips from entering in and interfering with the mechanism. This is just ONE of the major improvements incorporated in the new "GA" Gridley. This machine is the culmination of more than 30 years experience in the design and manufacture of Automatic Screw Machines. Advance detailed information is given in Bulletin "GA-A."

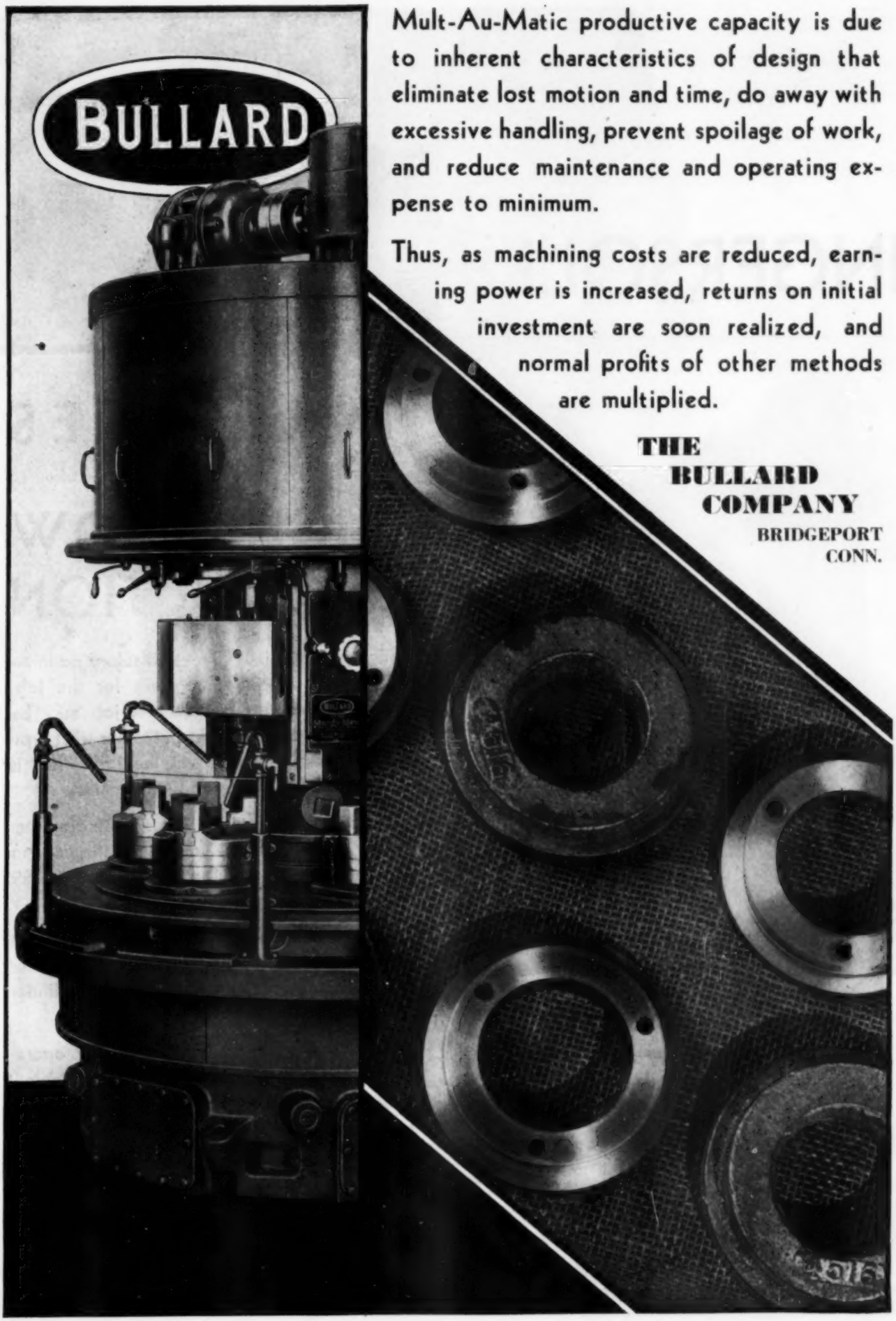


AND REMEMBER:—Gridley Automatics are built ONLY by The National Acme Company of Cleveland, O., at Windsor, Vt.

REG. U.S. PAT. OFF.

THE NATIONAL ACME CO.

Cleveland, Ohio • *Branches*—New York Chicago Detroit • *Machinery Plant:* Windsor, Vt.



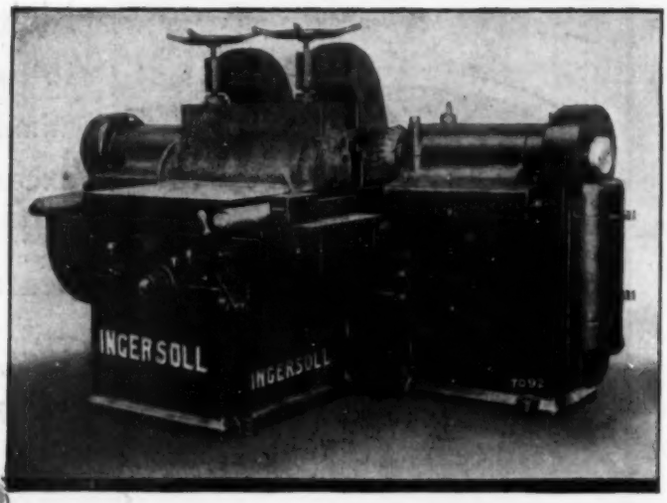
Mult-Au-Matic productive capacity is due to inherent characteristics of design that eliminate lost motion and time, do away with excessive handling, prevent spoilage of work, and reduce maintenance and operating expense to minimum.

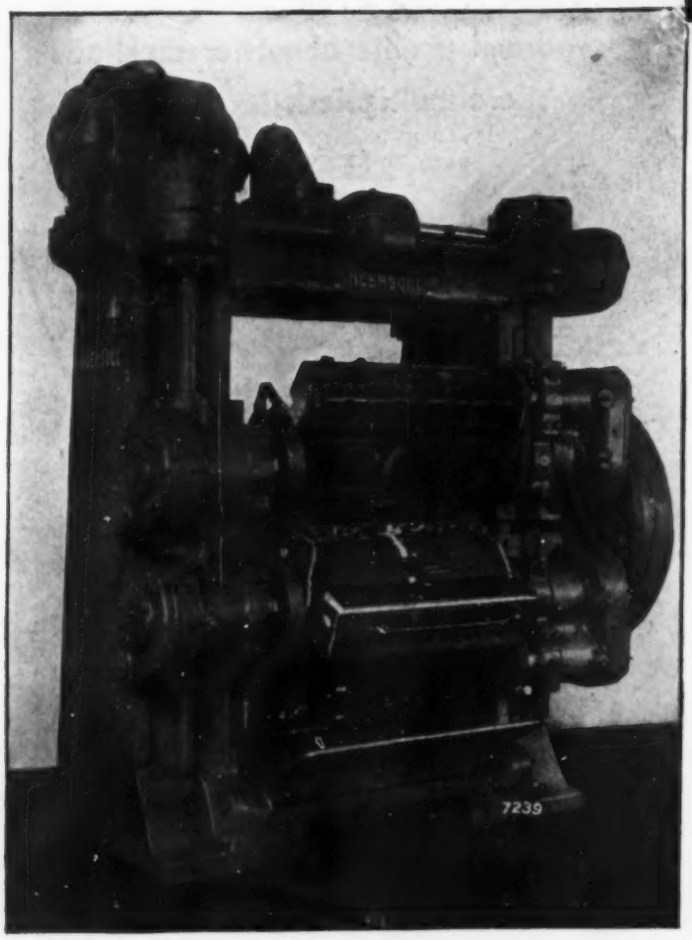
Thus, as machining costs are reduced, earning power is increased, returns on initial investment are soon realized, and normal profits of other methods are multiplied.

THE BULLARD COMPANY

BRIDGEPORT CONN.

INGERSOLL





MACHINES FOR HIGH OR LOW PRODUCTION

Ingersoll machines give satisfactory performance because they are built for the job. The problem is not how the job may be adapted to the machine, but rather what type of machine will best suit the job. This is determined by your job requirements.

The machine at the left is a six spindle drum type milling machine for milling the ends of cylinder blocks. The production is 29 cylinder blocks per hour.

The two horizontal spindle milling machine at the top performs a similar operation for another manufacturer. Production is 11 cylinder blocks per hour.

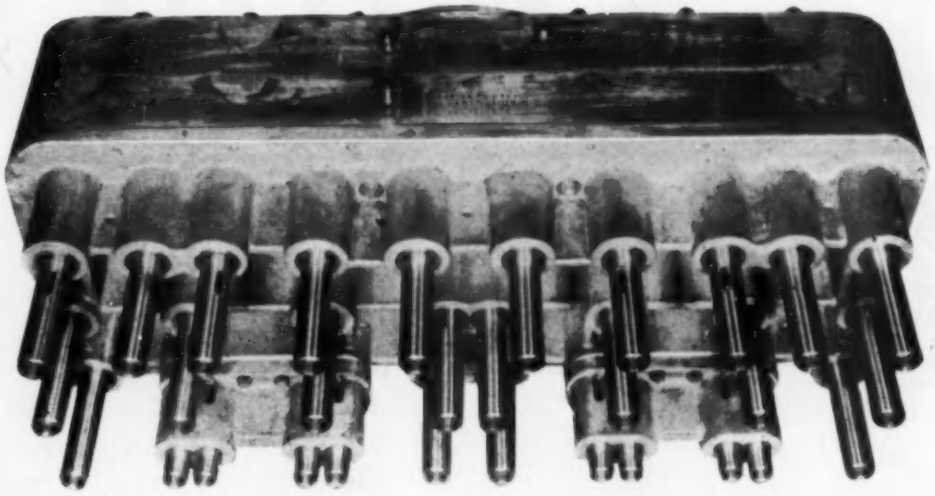
These two machines perform similar operations but the difference in design was determined by the production requirements.

BULLETINS:

No. 46 "Ingersoll Equipment for Railroad Shops"
No. 47 "Ingersoll Milling Machines"
No. 49 "Ingersoll Milling Cutters"

THE INGERSOLL MILLING MACHINE COMPANY ROCKFORD ILLINOIS, U. S. A.

Built to Stay on the Job

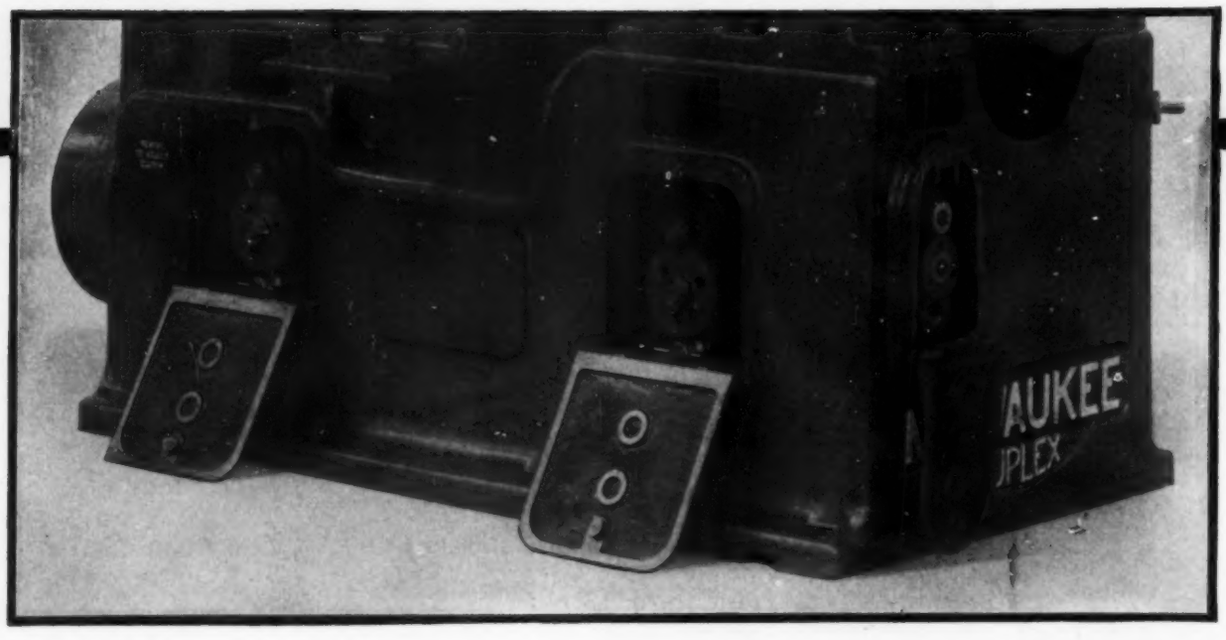


Multiple Spindle Drill heads built with New Departure Ball Bearings on spindles and drive gears stay on the job, day in, day out. They are accurate and sturdy. The unit illustrated shows a U. S. Drill Head Company product in which 102 New Departures are used. In operation it is smooth and fast — needs little attention — and economizes power. The generous thrust capacity and compactness of New Departures fit them particularly well for all kinds of drilling machines. There is a heap of truth in the statement: Nothing rolls like a ball. The New Departure Manufacturing Company, Bristol, Conn.; Detroit, Chicago, San Francisco.

NEW DEPARTURE BALL BEARINGS

1751

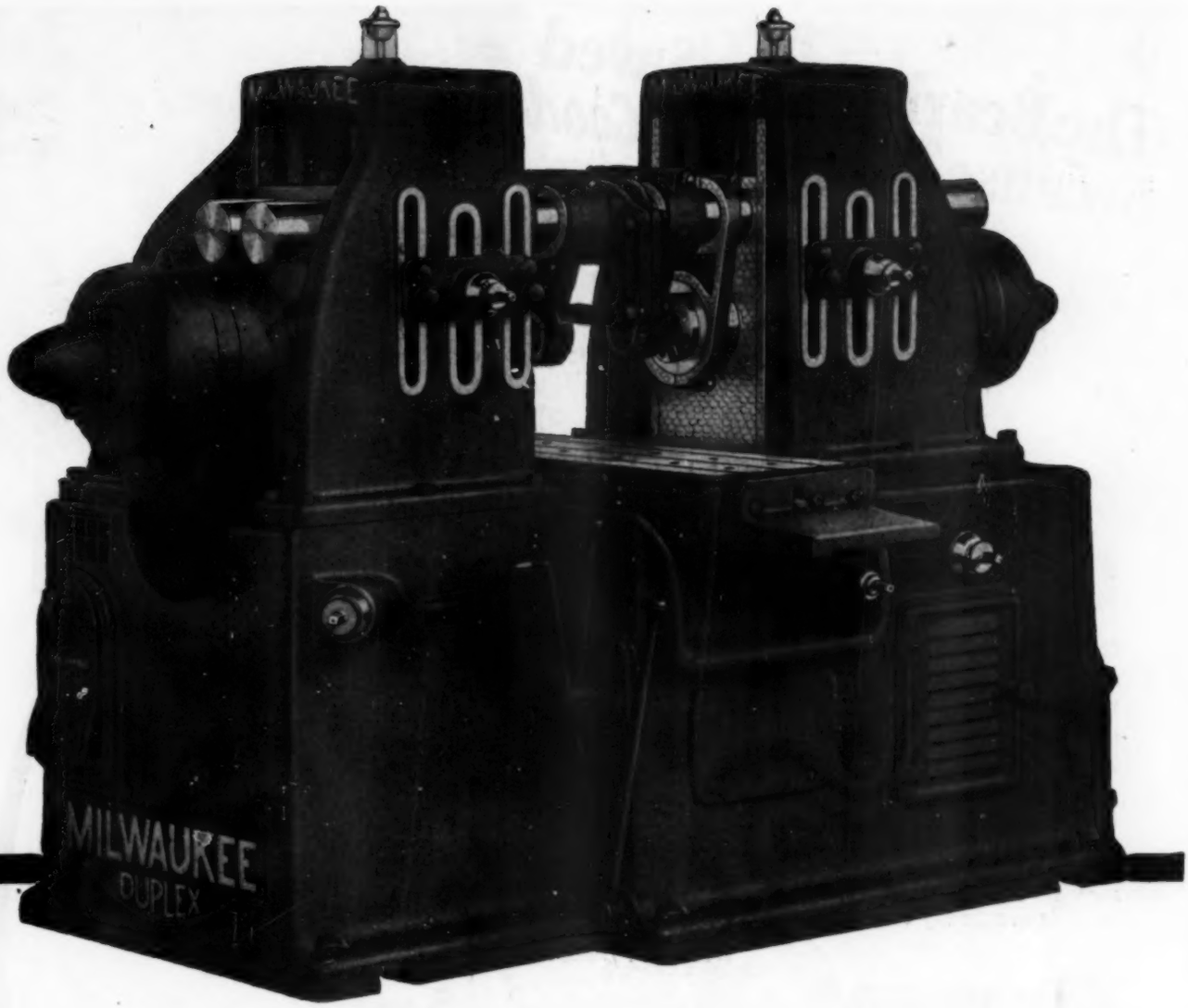
3 ranges-36 changes of SPEED for each spindle of the NEW MILWAUKEE DUPLEX



Three independent speed-ranges are available for each spindle of the NEW MILWAUKEE DUPLEX . . . 15 to 150 r. p. m., 30 to 300 r. p. m., and 100 to 1000 r. p. m. With each of these ranges are twelve speed-changes, independently controlled for each spindle. Thus it is possible to provide one spindle with any one of the three speed-ranges, while the opposite spindle may be operated with either of the other two speed-ranges. Pick-off gears are conveniently located as shown above, and the speed-changes may be made quickly.

There is also a choice of three ranges of table-feeds . . . ½ to 20 inches per minute, 1 to 40 inches per minute, and 2½ to 100 inches per minute . . . and each range includes 18 individual power feeds . . . in addition to power rapid traverse of 240 inches per minute.

IF IT CAN BE MILLED — MILL IT FASTER



COST-CUTTING opportunities multiply immediately when the NEW MILWAUKEE DUPLEX goes to work. With your choice of three independent speed-ranges for each spindle, and twelve speed-changes in each range, cutters of different sizes may be used together . . . a small face may be finished on one side of a workpiece while a much larger face is being machined on the opposite side. Linked with the unique ability of this DUPLEX for modern high-speed milling with Tungsten Carbide cutters, these advantages place tremendous milling possibilities within reach of all who recognize the necessity of reducing costs to bring back business!

Now . . . more than ever before . . . good management *dares not* tolerate obsolete equipment. Replace and return to normal profit through lower costs. You can do it with the NEW MILWAUKEE DUPLEX and SIMPLEX!

KEARNEY & TRECKER
MILWAUKEE
MILLING MACHINES

with the **NEW MILWAUKEE SIMPLEX AND DUPLEX**

The Bearings Are Saved Because *They Are Still Good*

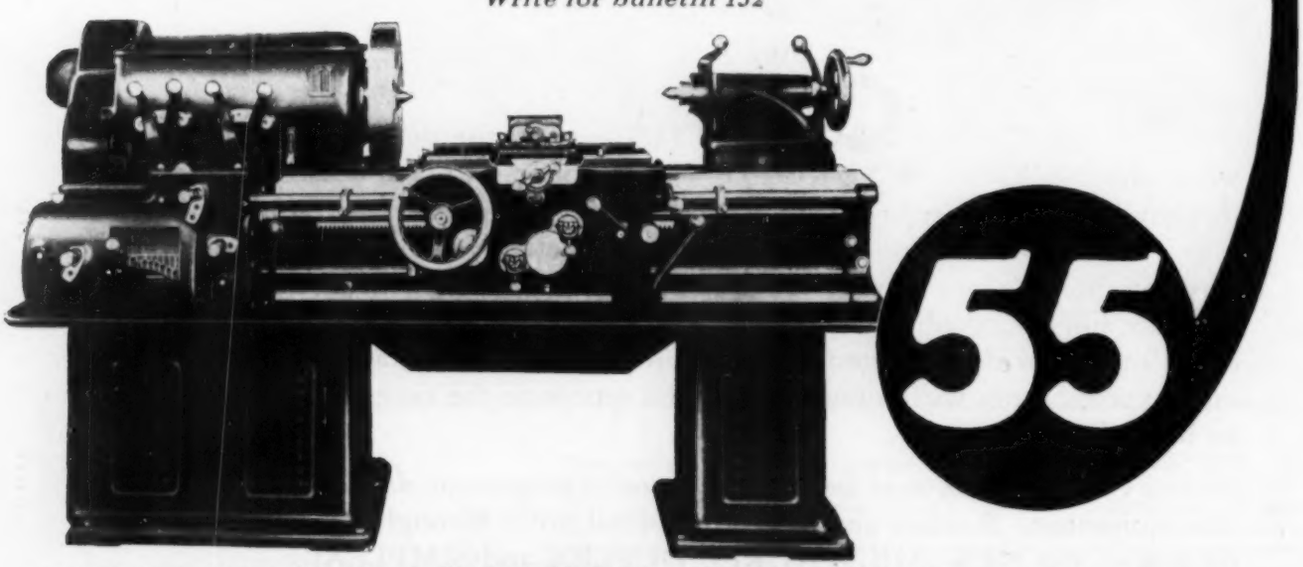
GOOD anti-friction bearings are almost never found in an automobile "graveyard." Why? Because after having carried the burdens of the car for many thousands of miles, they are practically unworn—almost as good as new. Such bearings are invariably salvaged and sold as replacements.

The same holds true of the anti-friction bearings used in Monarch Lathes. Even after many years of continuous service, the bearings show practically no signs of wear. They may be salvaged and used again, when the lathe is eventually discarded.

The above photograph shows the 55 anti-friction bearings, ball and roller types, used in Monarch Model "C" tool room lathes. In fact, more non-wearing, anti-friction bearings are used in this lathe than in any other lathe built. Their extensive use practically eliminates wear—and gives to this lathe an extreme original accuracy that lasts an incredibly long time.

Monarch engineers can help you solve your turning problems. Send blue print of the job on which you would like to have comparative cost figures.

Write for bulletin 132



THE MONARCH MACHINE TOOL COMPANY, Sidney, Ohio, U. S. A.

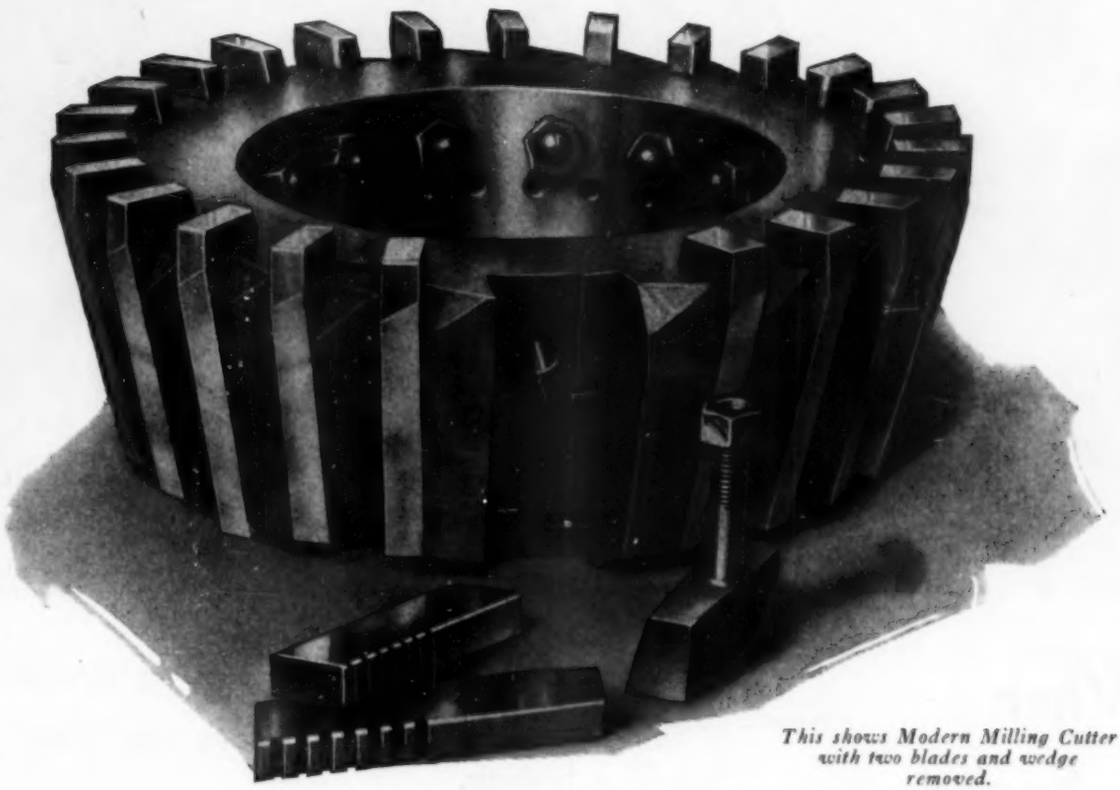
New York Sales Office: 857 Graybar Bldg. Chicago Sales Office: 547 W. Washington Blvd.

Monarch lathes

Helical Gears - Timken Bearings

SMOOTHER..QUIETER..MORE POWERFUL

Why these Cutters are Producing more pieces per grind



This shows Modern Milling Cutter with two blades and wedge removed.

On semi-roughing and finishing cuts, a large number of blades come into contact with the work per revolution of the cutter.

The larger number of blades permits lighter chip load per blade, resulting in more pieces per grind and life of blade.

MODERN
INSERTED BLADE MILLING CUTTER

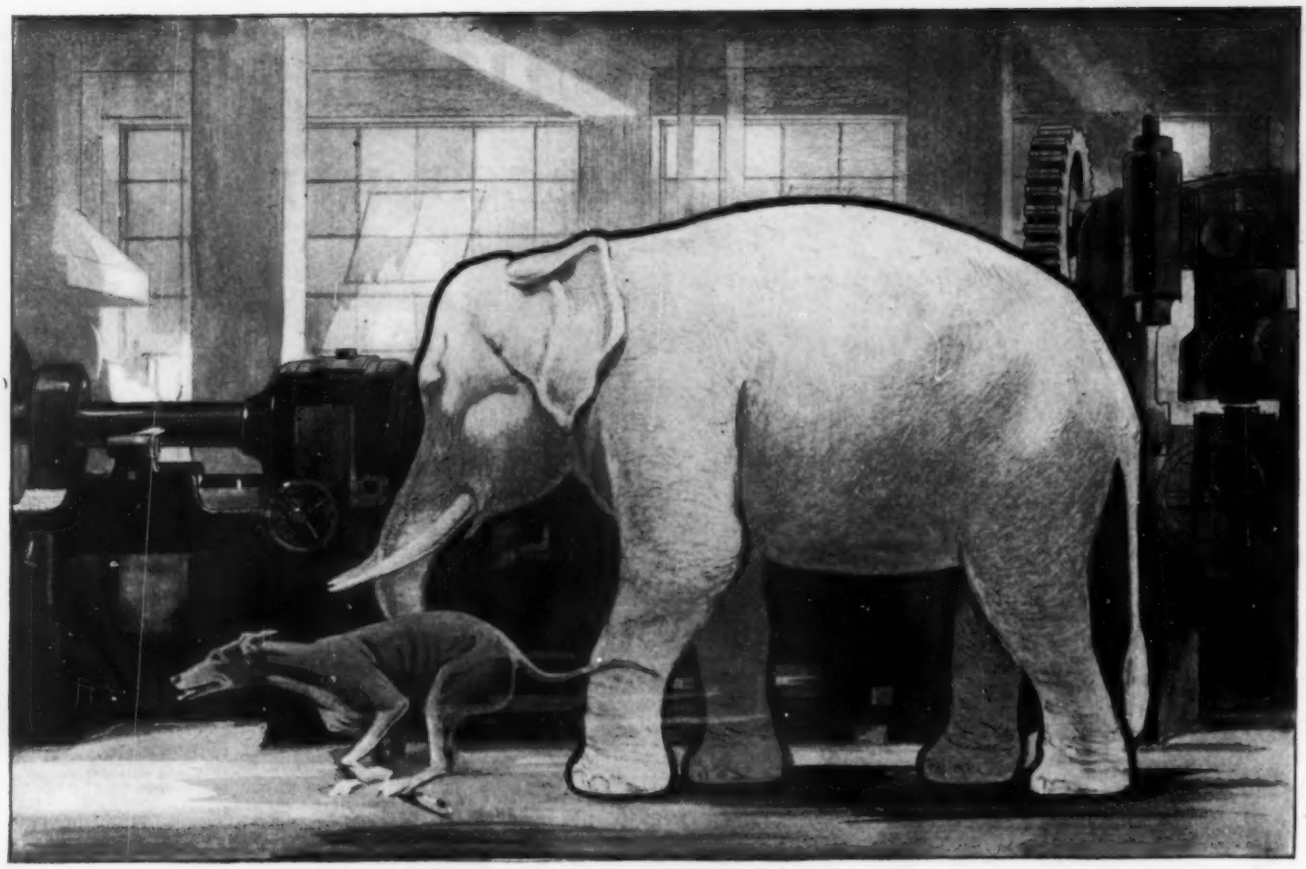
Can be furnished with High Speed Steel or Stellite and in either case have the same number of blades per cutter.

Complete information will be mailed on request.

Modern Tool Works

ROCHESTER, N. Y., U. S. A.

Division of Consolidated Machine Tool Corporation of America



When Speed Counts

In busy times when "short" deliveries are demanded.

In dull times when production costs may "make" or "break" a business.

When output must be increased.

When floor space is a factor—to increase capacity without adding plant area.

Surely it is a day of speed, plant-production speed. Quick deliveries and service are valuable assets in all times.

Tool up the plant to win against competition.

Eliminate the plodding "white elephants."

For Grinding Machines—
NORTON COMPANY
WORCESTER, MASS.

NORTON

GRINDING & LAPPING MACHINES

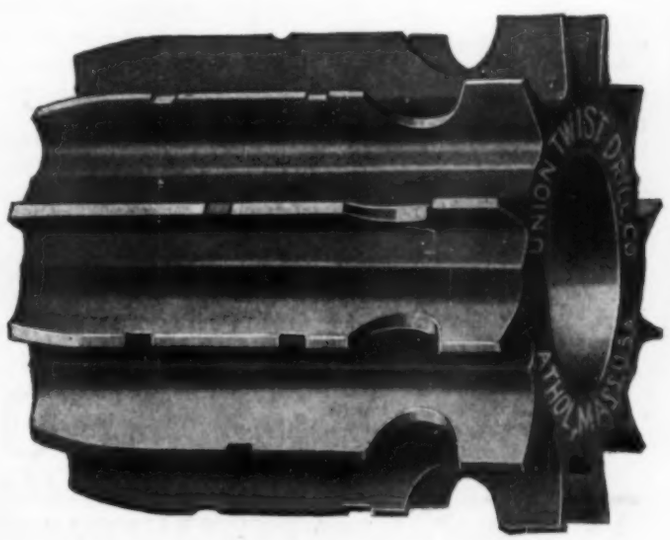
UNION formed CUTTERS

You can purchase Union Formed Cutters secure in the knowledge that they will never default in the important matters of precision, long life and resultant low costs. Their consistent performance in leading shops everywhere is ample proof that it pays to invest in cutters of established quality.

"The Tools You Buy Again"

UNION TWIST DRILL CO.
Athol, Mass., U. S. A.

New York Store: 62 Reade St.
Chicago Store: 11 So. Clinton St.
San Francisco Store: 121 Second St.
Mansfield, Mass. Derby Line, Vt.
Rock Island, Quebec

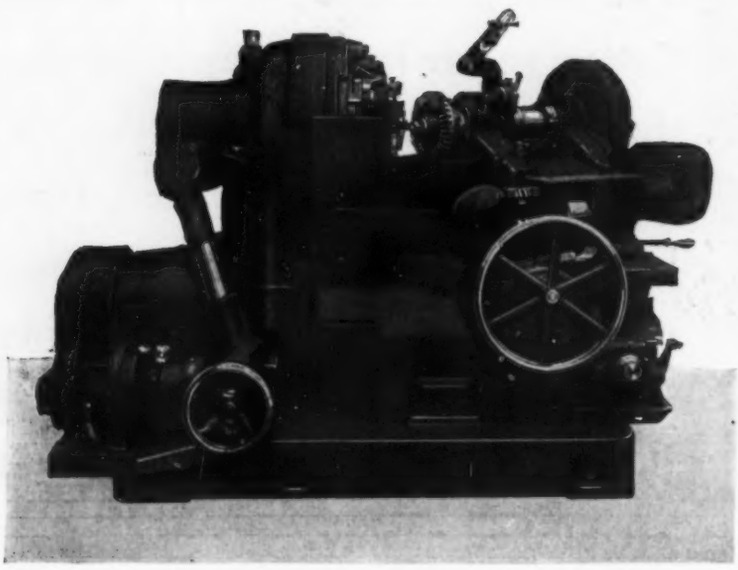


This Union Formed Cutter has milled 85,000 pieces and is still good for many more.

Makers of a complete line of Cutters, Twist Drills, Reamers, Taps, Dies, etc.

SIX FEATURES

OF THE 12" STRAIGHT BEVEL GEAR GENERATOR



12" Straight Bevel Gear Generator

1 *High Quality Gears*

2 *Greater Production*

3 *Fully Universal**
(For Rough and Finish Cutting)

4 *Automatic Operation*

5 *Easily Set-Up*

6 *Low Upkeep Costs*

SPECIFICATIONS	
Longest cone distance (3-½" face)	12"
Longest cone distance (1" face)	10½"
Greatest Pitch Angle (Shafts at 90°)	84°18'
Greatest Pitch Angle (Angular Gears)	90°
Extreme Ratio	10-1
Largest Diameter Gear, 10-1 ratio, 3½" face	24"
2-1 ratio, 3½" face	21½"
1-1 ratio, 3½" face	17"
Largest Pitch	3 D.P.
Longest face	3½"
Index Range (No. of Teeth)	10-200

Fully Universal*

THIS machine is a complete unit for both rough and finish cutting Straight Bevel Gears. It is equipped with a double track cam to facilitate changing from one operation to the other and its design is sufficiently rigid to permit roughing any gears within the range of the machine.

It is economical to both rough and finish cut gears on this machine in quantities as small as a single pair. Gears and pinions can also be cut on a production basis on this machine.

Gears from the smallest sizes up to the largest capacity of the machine can be cut with equal efficiency. Extremely high speeds are available for cutting the smaller gears, while the rigid design of the machine enables it to cut the larger sizes at a rapid rate of feed. Tool speeds from 85 to 442 strokes per minute are available, and the machine will cut gears at feeds ranging from 7.6 to 86 seconds per tooth.

A complete set of equipment, except cutting tools and arbors, is furnished with each machine.

GLEASON WORKS

Builders of Bevel Gear Machinery for Over Sixty Years

1000 UNIVERSITY AVENUE, ROCHESTER, N. Y., U. S. A.

PATENTED

CINCINNATI

FASTER *by* 100%

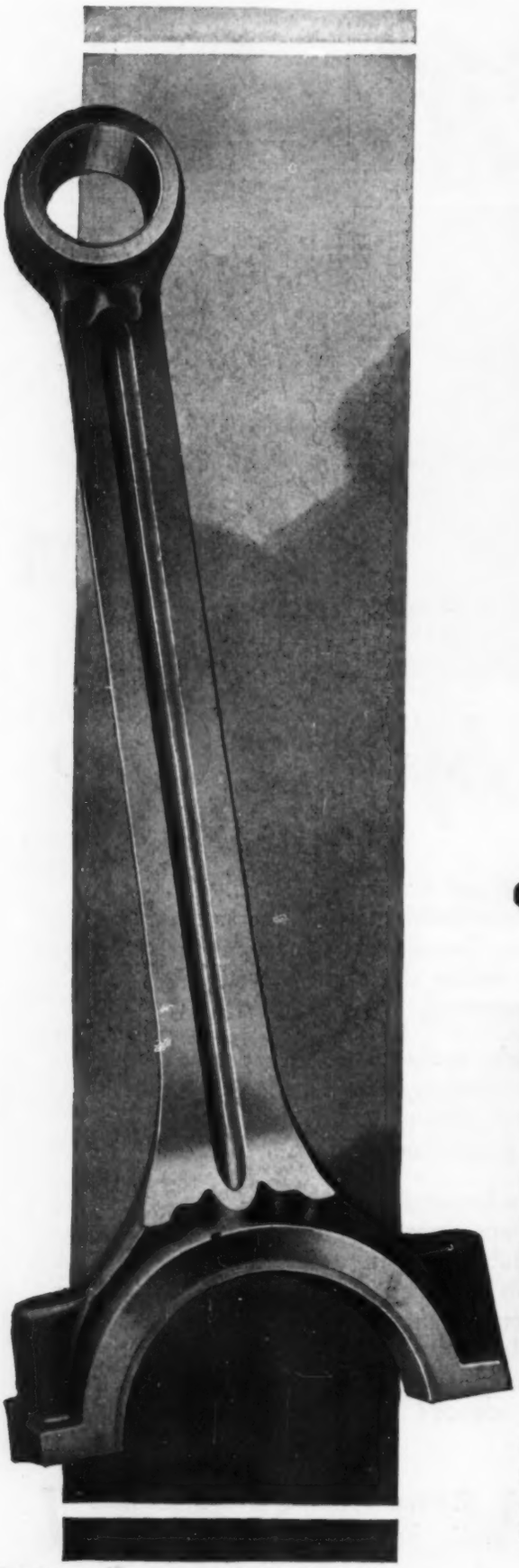
Double the output... 96 per hour per machine... formerly 48. These five Cincinnati Self-Contained Saddle Type Grinders are giving this profitable performance. Two diameters on hardened steel hydraulic shock absorber rocker shafts are accurately ground, .020" of stock being removed.

Duplex aloxite grinding wheels, easily controlled operation, rapid metal removing capacity, and excellently designed construction features combine to enable the user to maintain this 100% production increase.

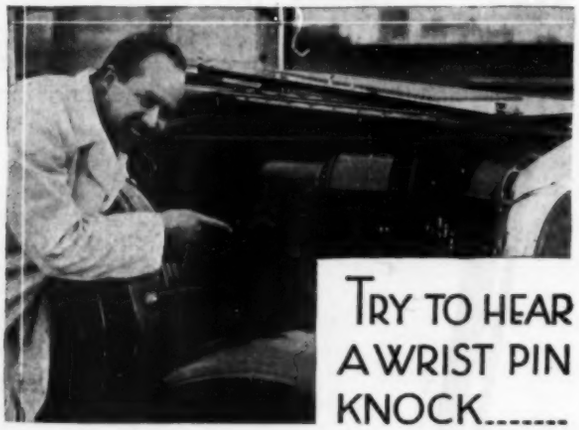
Cincinnati precision grinders far overshadow the performance which obsolete equipment gave on this job. With production doubled, the user receives a much larger return on his investment. Are you using obsolete grinding equipment in your shop which you should replace by modern Cincinnati Grinders, so as to keep your plant earning the proper dividends?

Put your cylindrical grinding problems up to our Service Engineers

CINCINNATI GRINDERS INCORPORATED, CINCINNATI, OHIO, U.S.A.



Why you should adopt rifle-drilled connecting rods



TRY TO HEAR A WRIST PIN KNOCK.....

We milled this connecting rod to show the "rifle-drilled" hole, ¼" diameter, 8" long, that delivers oil under pressure to the wrist pin. The P & W 6-Spindle Driller finishes one of these holes every 67½ seconds.

Next year more good cars

6-Spindle Vertical DEEP-HOLE DRILLER

This machine uses the well known *rifle barrel method* of drilling that has proved so effective. This principle has been combined with modern production methods of vertical construction, convenient work handling and with the newest cutting alloys for rapidly removing metal.

Make the wear come on the *OIL*

A motor knock caused by a poorly-fitted pin, or wear on the pin, is a mysterious but damning sound to the ears of a motorist. Few things will "unsell" him on his car quicker than this.

Perfect fitting when the car is made—working to costly ten-thousandths dimensions—is one way to avoid the ominous knock. Another, and a way that costs very much less, is to have the connecting rods rifle drilled for oil under pressure.

Then the wear comes on the oil. Worn oil is regularly and easily replaced. Worn metal, in such an inaccessible place, means very expensive repair work which ruins the reputation of the car, the maker, and the service station that does the work.

Only the most expensive cars could adopt this system until the development of the Pratt & Whitney, 6-Spindle, Deep Hole Driller, which makes rifle-drilled connecting rods available to the makers of any good cars. The cost is so ridiculously low as to be practically negligible.

Write for a circular that describes this machine, or ask any of our offices to send a sales engineer with full data.

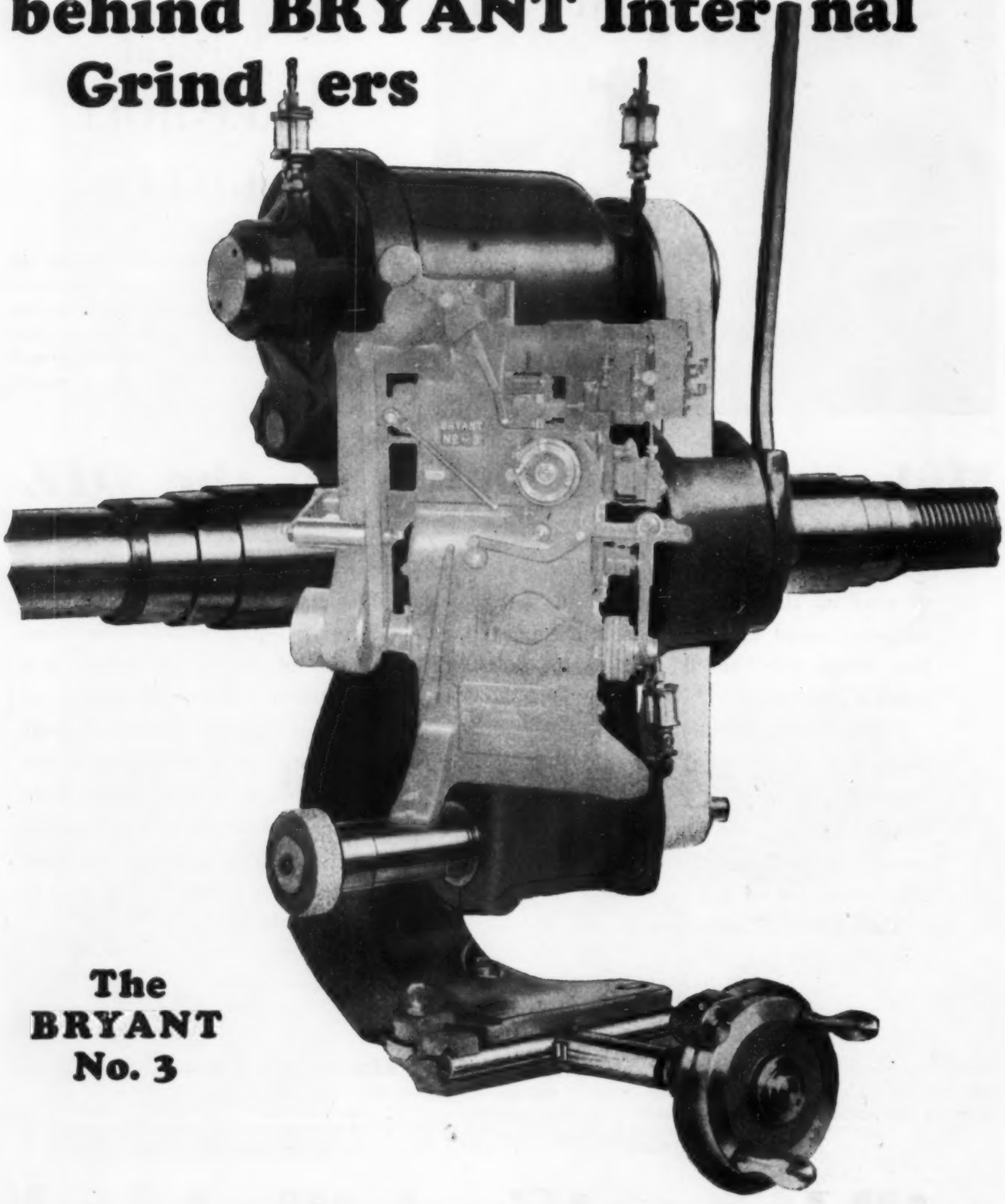
PRATT & WHITNEY CO., *Hartford, Conn.*

Sales Offices and Agencies at

BIRMINGHAM	CHICAGO	DETROIT	PHILADELPHIA	SAN FRANCISCO
BOSTON	CINCINNATI	LOS ANGELES	PITTSBURGH	ST. LOUIS
	CLEVELAND	NEW YORK	ROCHESTER	

will have rifle drilled rods

THREE POINT CONTROL
the Fundamental Guarantee behind BRYANT Internal Grinders



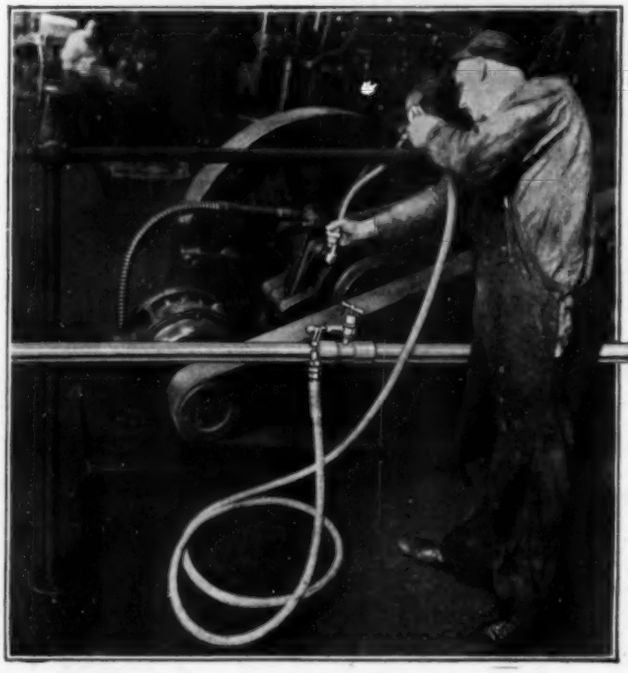
The
BRYANT
No. 3

BRYANT CHUCKING GRINDER CO. Springfield, Vermont

NOW . . . pipe lubricant *where* and *when you want it* . . . . Just Like Steam! . . . . . .

(Above) The Alemite PA 400 Compressor; capacity 410 lbs.

(Below) Safe and clean—with individual lubrication and inspection for every bearing.



There Is No Longer Any Need To Carry It Around!

HERE is the new Alemite development that makes lubrication amazingly simple and absolutely *sure!* Just fill the Alemite High Pressure Master Pump with an entire barrel of fresh lubricant. Then, when the power is turned on, the lubricant is immediately available under high pressure *anywhere* in your plant that you may care to pipe it.

Outlets can be conveniently located. Your operator can instantly attach a 20-foot flexible high pressure hose to any outlet—enabling him to lubricate every bearing within the radius of a 40-foot circle by simply attaching the hose coupling to the Alemite fitting on the bearing.

By operating the release valve in the high pressure hose line the operator can give every bearing *individual* attention and completely control the amount of lubricant put into each bearing.

Thus, lubricant reaches the bearings as clean and fresh as the day it left the refinery—and it is conveyed to the point where you need it in the same practical manner that steam and water are now piped throughout your plant.

This Alemite High Pressure Master Pump is but one of 7000 lubrication appliances which Alemite designs and builds for industrial use. Today, more than 12,000 leading manufacturers use these Alemite appliances for lubrication of their machinery—and practically all leading machinery manufacturers now furnish Alemite fittings as standard equipment.

Industrial lubrication service and information are available to you through all of Alemite's 49 offices, where Alemite Lubrication Experts are stationed. Without obligating yourself in any way, mail the coupon today for full details of the specialized lubrication service Alemite offers to modernize lubrication in *your* plant.

ALEMITE

ALEMITE CORPORATION 471
(Division of Stewart-Warner)
2676 N. Crawford Ave., Chicago
Please send your representative to our office (or send complete details of your plan)

Name.....

Title.....

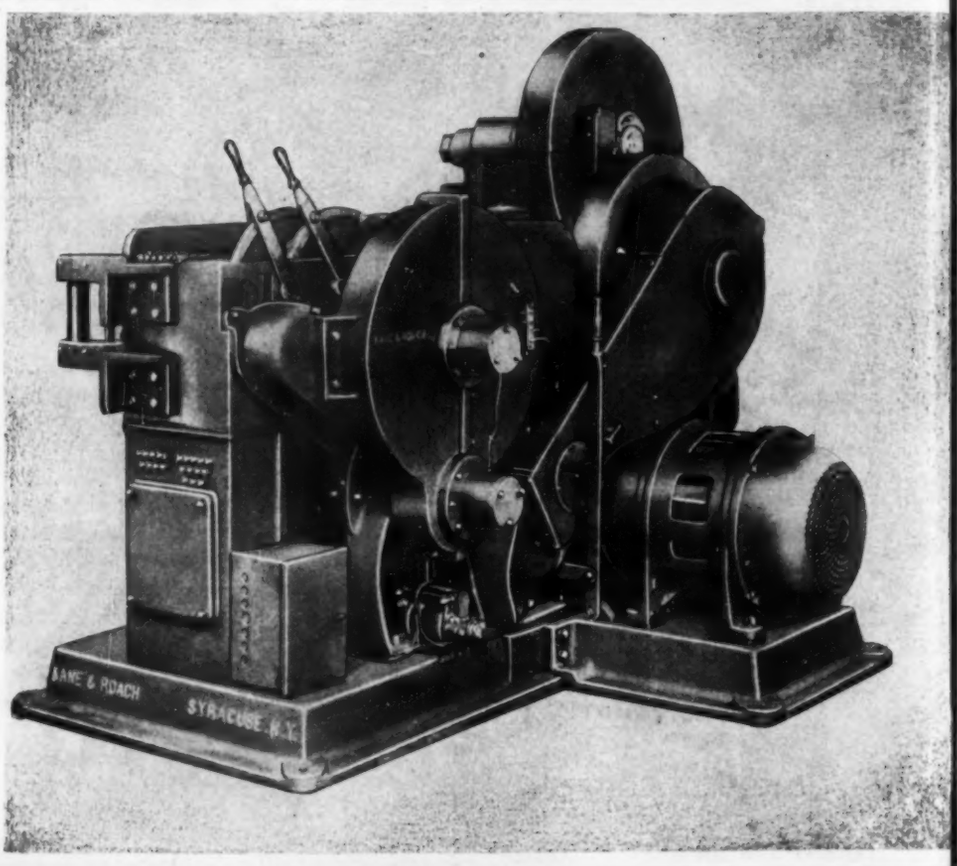
Firm Name.....

Address.....

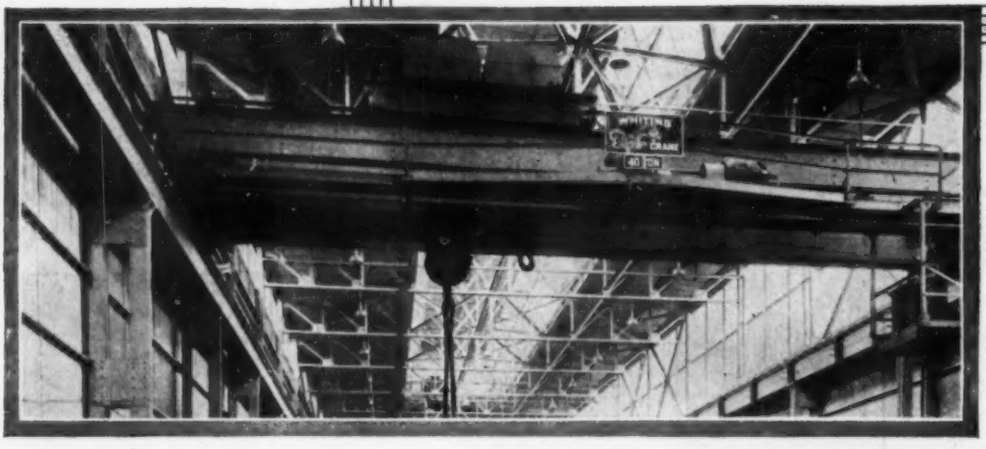
City..... *State*.....

The Shrewd Manager is

MACHINERY BUILDERS OFFER YOU NEW AND IMPROVED MACHINES



A modern Kane & Roach Coil Bending Roll equipped with the new CS Motor.



Efficient handling of materials plays an important part in earning profits. This 40-ton Whiting Tiger crane is equipped with 4 Westinghouse a-c. Crane Motors.

Westinghouse engineering service is available to help assure the efficient application of Westinghouse Motor Drives to your products, or to machines in your plant.

modernizing his plant *now* to insure *future profits*

HE is taking advantage of machine idleness to replace obsolete units with modern equipment.

And when he buys new machines he generally specifies Westinghouse motor drives because he knows that much of the responsibility for profitable performance rests upon the electrical equipment.

The radically-new CS motor brings to industry a highly efficient tool for securing more continuous operation of motor-driven equipment. It has a Pre-wound Core which is renewable and interchangeable, thereby providing new speed of repair and lower inventories of renewal parts.

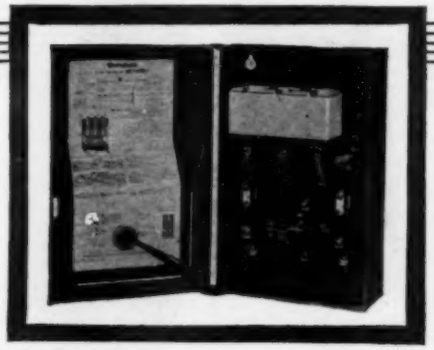
These new advantages together with such time-tested features as Sealed Sleeve bearings, dual-protected windings and directed air circulation make this new CS the best value in a-c. motors today.

For d-c. applications standardize on SK motors and Timestarters. Since their development, more SK motors have been chosen to drive industry's machines than any other general purpose d-c. motor—convincing proof of their superior performance.

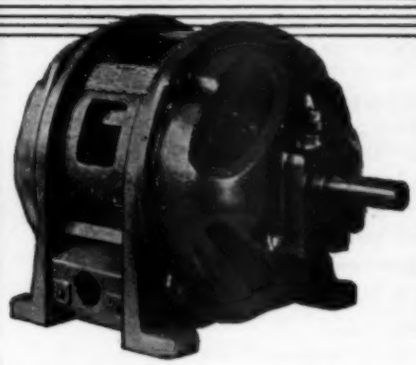
Westinghouse can serve you with motors for any application from 1/150 horsepower up and can also supply power transmission apparatus—Cog-Belts and Westinghouse-Nuttall gear units.

If you have a plant modernization program write to the nearest Westinghouse office for a copy of Reprint 432. It describes how Westinghouse is solving the ever-present problem of obsolescence.

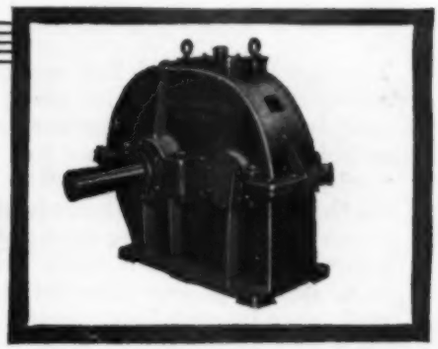
Westinghouse offers you Modern Motor Drives



The Linestarter gives you the economies and conveniences of push button operation at low cost. Contact burning is minimized by the instantaneous action of the exclusive "De-ion" arc quenchers.



The distinctly different motor—the Westinghouse CS—has interchangeable electrical units.

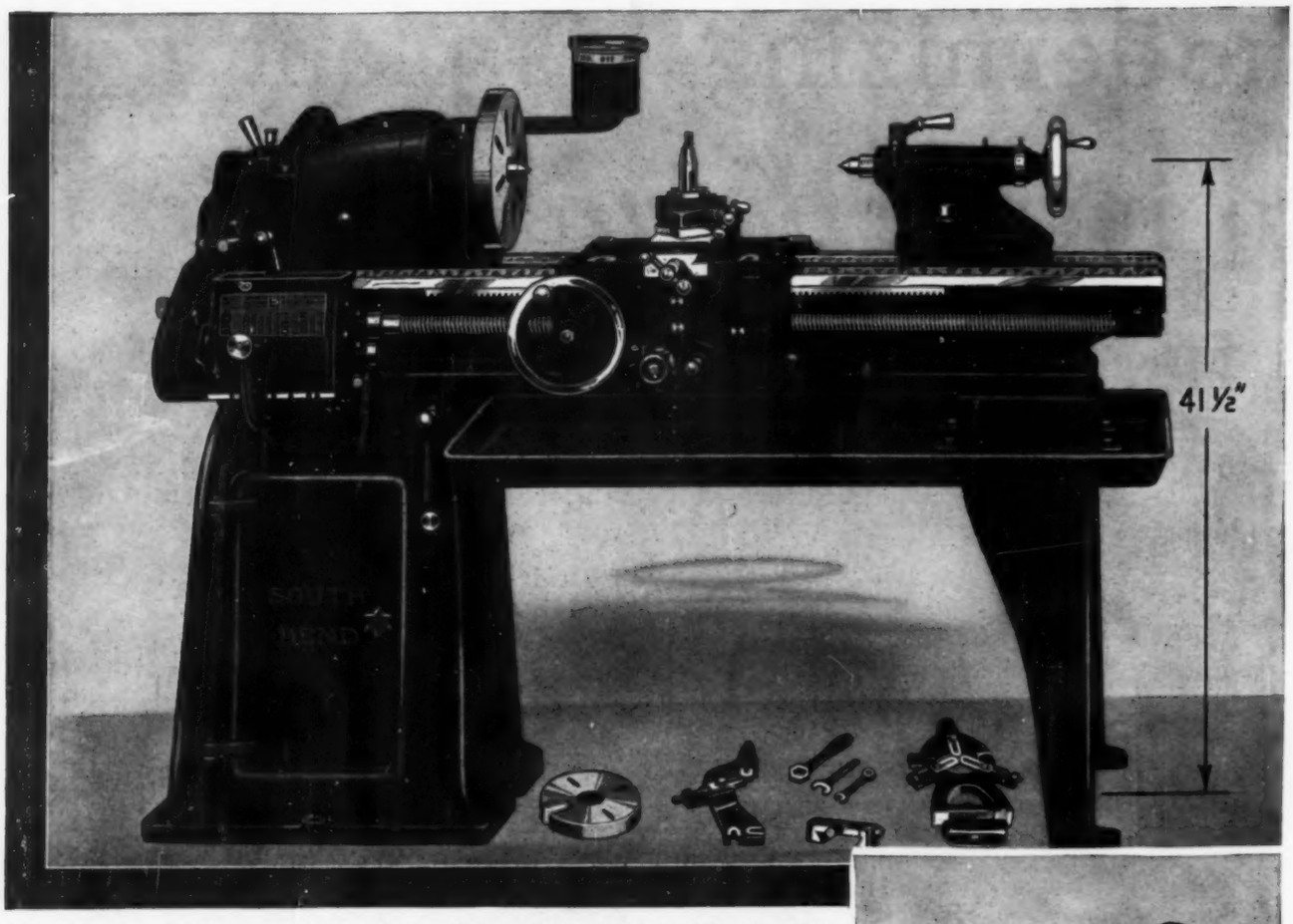


Westinghouse-Nuttall Speed Reducers and Flexible Couplings are built for any application. Standard units are available from 1 to 635 horsepower with ratios up to 70.5 to 1.

Service, prompt and efficient, by a coast-to-coast chain of well-equipped shops

Westinghouse

T 31889



13" x 5' Series "N" Underneath Belt Motor Driven Lathe. Weight 1510 lbs. Price with 3 phase motor, equipment and oil pan as shown $670. Without oil pan $643.

New Underneath Belt Motor Driven South Bend Lathe

Now on display in all the principal cities of the United States

The *New* Underneath Belt motor driven lathe is a compact, self-contained, powerful unit, with the motor and drive unit fully enclosed. This new lathe provides clear vision, is noiseless in operation and has the precision for the finest work. Furnished in both Series "O" and Series "N" with all the latest and most modern improvements that make them practical for the finest work in the manufacturing plant, for tool room work and production, and in the machine shop. Two complete lines of lathes, with 96 sizes and types in each line, provide a lathe for every purpose.

Prices of Popular Sizes

Underneath Belt Motor Driven Lathes with 3 phase, A.C. Motors and Regular Equipment

Size of Lathe	Weight	Standard Change Gear Series "O"	Standard Change Gear Series "N"	Quick Change Gear Series "O"	Quick Change Gear Series "N"
9" x 3'	690 lbs.	$353.00	$378.00	$398.00	$423.00
11" x 4'	920 lbs.	448.00	478.00	498.00	528.00
13" x 5'	1510 lbs.	542.00	583.00	602.00	643.00
15" x 6'	2025 lbs.	645.00	695.00	720.00	770.00
16" x 8'	2470 lbs.	737.00	795.00	817.00	875.00
18" x 10'	3440 lbs.	961.00	1029.00	1051.00	1119.00
9" x 3' Jr.	650 lbs.	283.00	Not made	328.00	Not made

Write for catalog on Underneath Belt Motor Driven Lathes.
A copy will be sent free, postpaid, on request.

South Bend Lathe Works

231 East Madison Street, South Bend, Indiana

End view of Lathe.
Front view with door and cabinet leg partially broken away to show driving mechanism.
Rear view of new double wall apron used on Series "N" Lathes.
End view showing Motor Drive with 2 "V" driving belts.

For True Fits in Assembly, Use Hanson-Whitney Taps "Finished after Hardening" by the Hanson Process

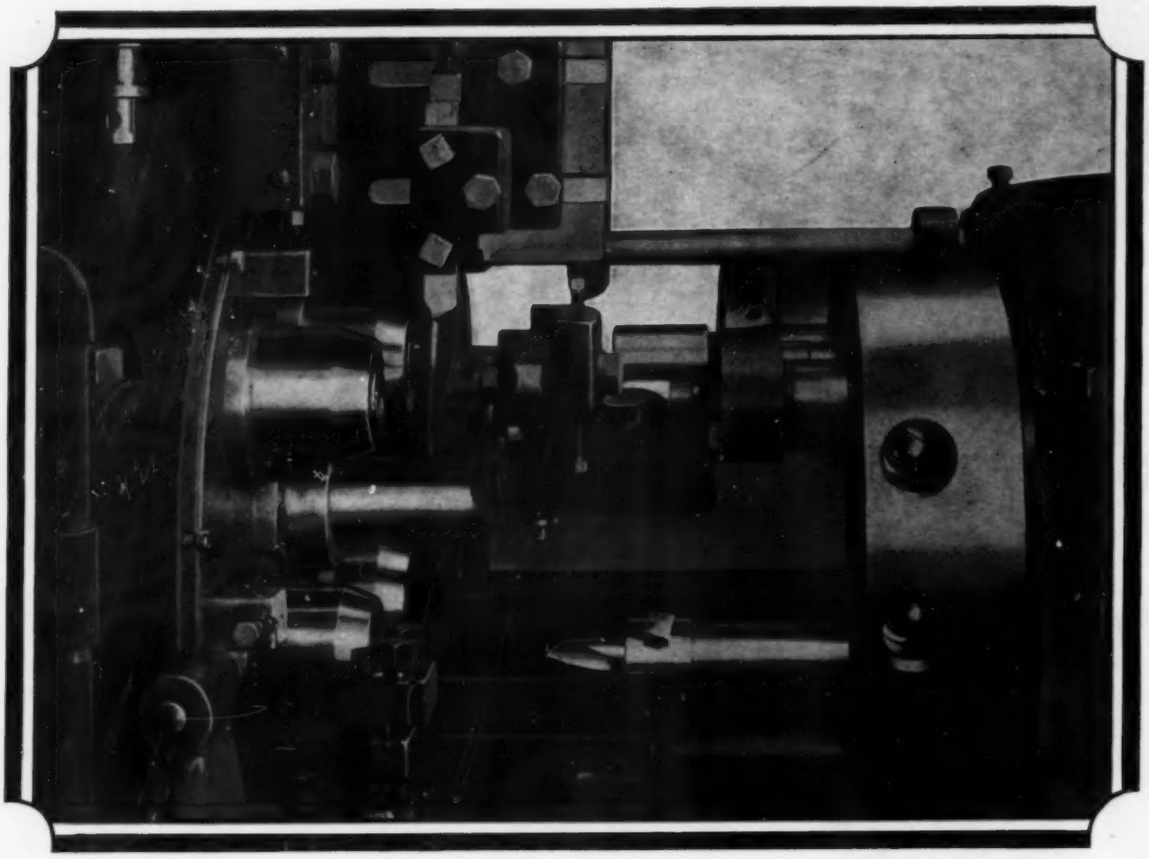
Do mated threaded parts ever have to be forced with a wrench in assembly? Or are they ever rejected because of loose fit? Hanson-Whitney Taps and other precision screw-cutting tools cut out this waste because they are "Finished after Hardening" by the Hanson Process. Thread forms are perfectly true, and lead accuracy is maintained within .0001" per inch. Thus the threaded pieces run together smoothly, fit as snugly as the master piece in its gage, and there's no lost time nor rejected work in assembly. Taps for every purpose, in all thread forms and leads, from 1-16 in. to 7½ in. diameter. And every tap is "Finished after Hardening." Send for catalog.

DOMESTIC REPRESENTATIVES

New York, N. Y., L. C. Biglow & Co., Inc.; Syracuse, N. Y., George McPherson; Philadelphia, Pa., D. J. Normoyle; Pittsburgh, Pa., William K. Stamets; Cleveland, Ohio, William K. Stamets; Cincinnati, Ohio, Seifreat-Elstad Mchy. Co.; Dayton, Ohio, Seifreat-Elstad Mchy. Co.; Detroit, Mich., A. G. Brice; San Francisco, Calif., A. H. Coates Co.; Chicago, Ill., K. H. Huntington; Toronto, Montreal & Vancouver, Canada, Arthur Jackson Machine Tool Co.

The Hanson-Whitney Machine Company

Hartford, Conn., U.S.A.



There's METAL *behind the* STROKE

of Cleveland Automatic End-Working Tools

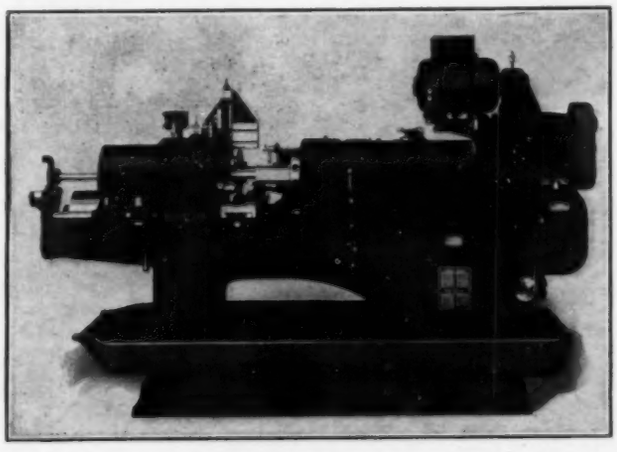
BEHIND THE SMOOTH, measured thrust of Cleveland turret tools is the weight of its substantial tool turret, moving in the broad bearing of a tool housing cast integrally with the bed.

The power and substance back of the stroke, as well as the breadth and accuracy of the ground and hardened bearing, make the Cleveland turret an ideal mounting for end-working tools and is an important factor in the lasting precision of Cleveland Automatics in the most exacting service.

CLEVELAND AUTOMATICS

Four turret tool positions are supplemented by four cross and top-slide positions for turning tools and a square turret attachment, also offering four mountings—giving Cleveland Automatics superlative convenience and adaptability, as well as flawless precision.

Let Cleveland engineers aid you to realize the net economy of rapid, trouble-proof machine production.



THE CLEVELAND AUTOMATIC MACHINE COMPANY

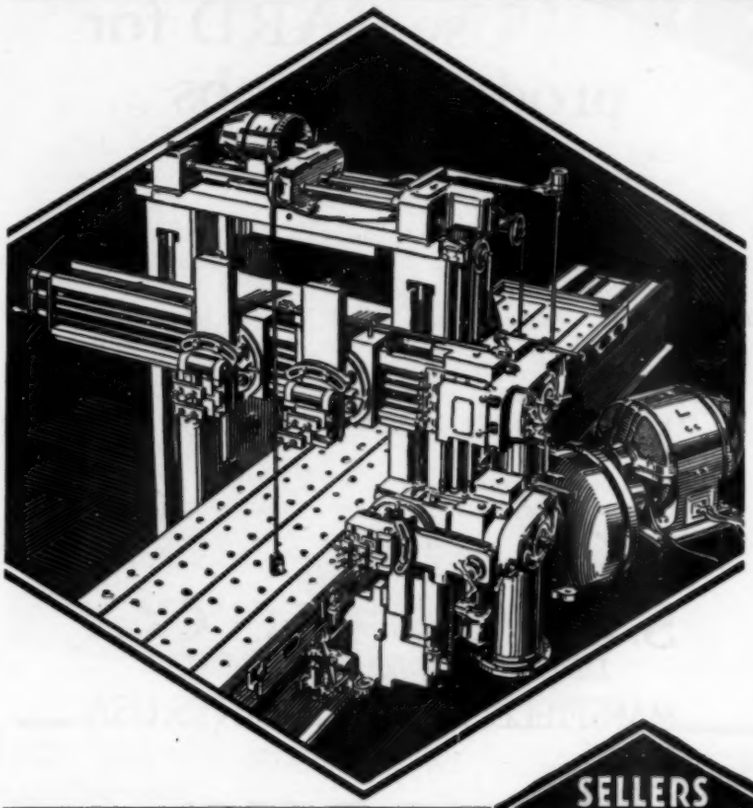
2269 Ashland Road, Cleveland, Ohio, U. S. A.

NEW YORK
95 Liberty Street

CHICAGO
565 W. Washington Boulevard

DETROIT
1217 Book Building

SPEED Webster says:—"Speed is the rate of motion, the degree of prosperity." If Webster had written his definition in 1931 with full recognition of the needs of modern industry, and a thorough understanding of the capabilities of Sellers Machine Tools, he could not have defined the word more appropriately.



SPEED in terms of output, of useful work, profitable operation—is inherent in the design of the Sellers Spiral Gear Planer.

Sellers Planers will operate at the highest speeds that modern cutting tools and methods permit. They will maintain their accuracy, superior finish, at any desired speed. They will speed production, reduce overhead, cut operating costs, and continue to deliver such service, year after year.

The name Sellers on a machine tool is sufficient to any shop operator as an assurance of unquestionable performance.

Base your decision on the knowledge of the man who knows. Then he will produce the results you are seeking.

SELLERS
MACHINE
TOOLS

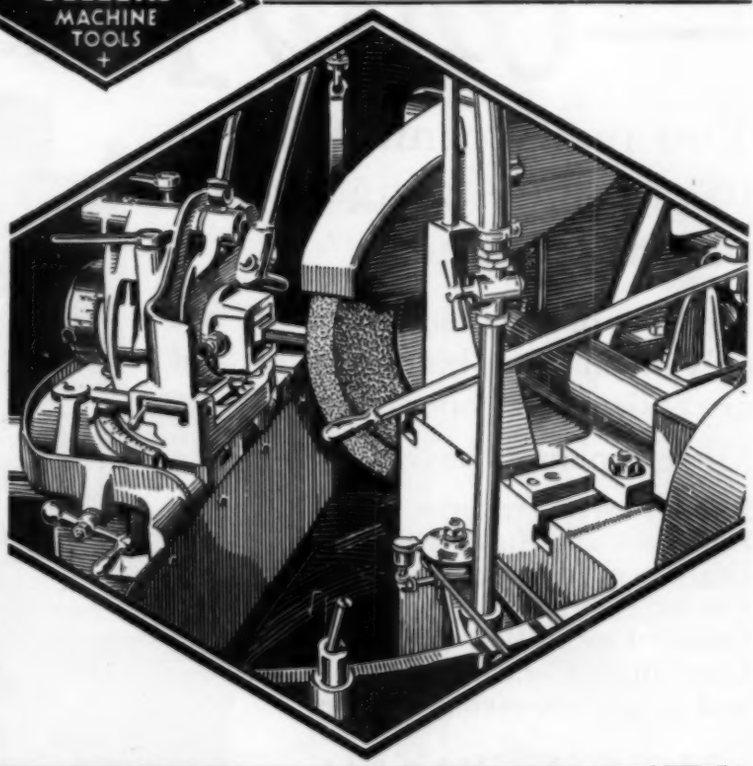
CORRECT shape of cutting tools is the first requisite for fast cutting.

Keen edge is the second.

Increased production through centralized grinding which saves operators' time and eliminates idle machine hours, is the third.

The Sellers Tool Grinder, itself, is a high speed machine which grinds tools automatically and with mechanical precision according to predetermined standards.

It will pay for itself, year in and year out, by saving men's time—saving waste of high priced tools—and by making machines work at their maximum capacity. Investigate.



WILLIAM SELLERS & COMPANY
ESTABLISHED 1848 **INCORPORATED** PHILADELPHIA, U.S.A.

HIGH SPEED STEEL Cut Thread

Use CARD for production jobs . .

Many shops running on production work show a decided preference for CARD High Speed Steel Cut Thread Taps over ground thread taps.

SOLD BY LEADING DEALERS EVERYWHERE

A TEST JUST REPORTED: CARD High Speed Steel Cut Thread tested against competitors' so-called Class 2 High Speed Steel Ground Thread.

Material—Steel forging. Blind hole 5/8 in. thread length. Drilled with 17/64 in. drill 3/4 in. deep. Tap 5/16-18 3 flute High Speed Cut Thread. Five competitors' High Speed Steel Class 2 Ground Thread Taps were used to produce 1175 holes. One CARD High Speed Steel Cut Thread Tap tapped 2200 holes.

Don't buy a "pig in a bag." Look carefully into the relative cost and performance of the tools. Then make your selection.

S. W. CARD MFG. CO.
DIVISION OF UNION TWIST DRILL CO.
MANSFIELD, MASSACHUSETTS, U.S.A.

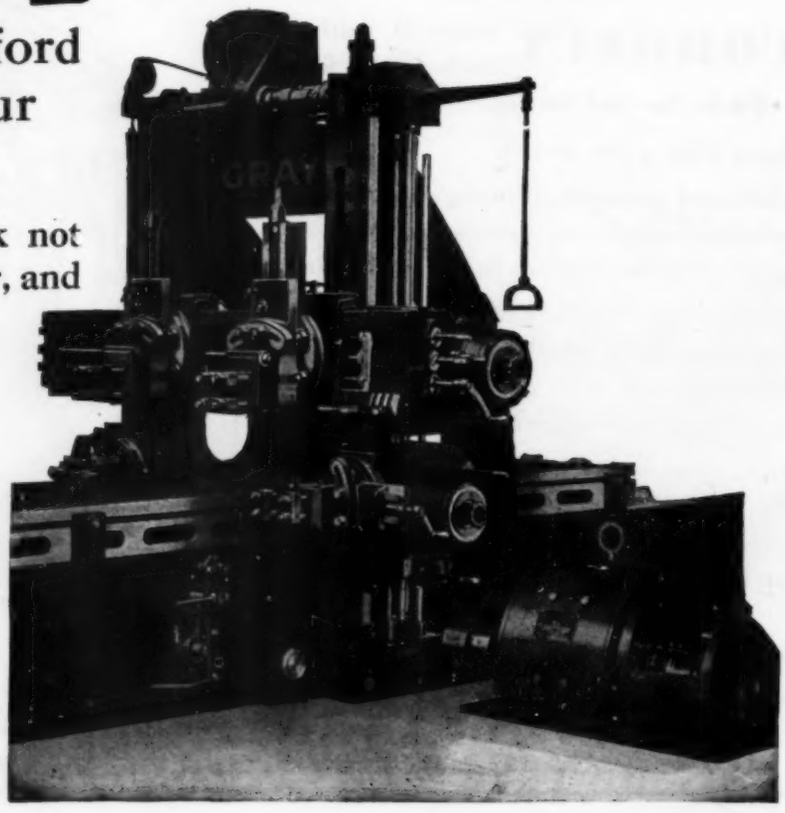
Gray Planers

You really cannot afford to continue using your old-style planers.

Modern planers do the work not only much faster but far better, and are easier on the operator.

Modern planers have:

Rapid Power Traverse
Rail-Lock and Rail-Setter
Dial-Feed, instantly set
Forced Lubrication
Double-Length Bed
Centralized Control
and other time-saving features.



THE G. A. GRAY CO.
CINCINNATI, OHIO
Maximum Service Planers
Open-Side and Double-Housing.

THE LANDMACO
Threading Machine

These features pay dividends in increased production and better work.

Gear Box . . . selective type . . . eight spindle speeds . . . hardened and burnished chrome nickel steel gears . . . alloy steel shafts . . . anti-friction bearings . . . friction clutch control.

Spindle . . . pre-loaded ball bearings . . . spiral bevel gear drive.

LANCO Head . . . high carbon steel heat treated and ground . . . Landis Ground Thread Chasers.

Pump . . . low pressure gear type . . . direct driven . . . reversing automatically . . . removable without disconnecting piping.

Motor Drive . . . motor-in-base . . . silent chain drive.

Lead Screw . . . centrally located . . . preloaded ball bearings . . . fully enclosed.

Lead Screw Nut . . . bronze-split full-nut type with adjustable segments . . . direct contact with carriage.

Write today for Bulletin H-75-1

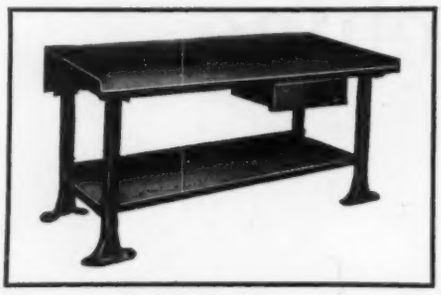
LANDIS MACHINE COMPANY, Inc.
WAYNESBORO, PENNA.

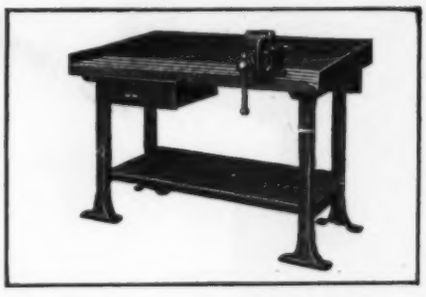
DETROIT: 5928 Second Blvd. CLEVELAND: 504-505 Marshall Bldg.

Agents in all principal cities of the world

LANDIS
for THREADING

SAVE WITH STEEL





IF you are not already acquainted with the 26 year old "NEW BRITAIN" line of STEEL SHOP FURNITURE and FACTORY EQUIPMENT allow us to introduce STEEL BENCHING-STEEL WORK STANDS—and all the rest of the line.

Steel never starts a fire, or feeds the flames. No warping, sagging, shrinking, or cracking can take place on steel benches. "Set 'em up" and there they are serviceable, durable and everlasting.

"NEW BRITAIN" ALL STEEL, or, LAMINATED MAPLE top, or COMBINATION LAMINATED MAPLE and STEEL top BENCHES, can be erected, individually or continuously, and taken down again for erection elsewhere in the shop without damage and with no extra cost, except for the necessary labor involved. May we suggest that you compare such benches, to the old style makeshift all wood benches, constructed out of odds and ends, which must be partly or totally destroyed, if it is desired to tear them down for erection in another part of the plant.

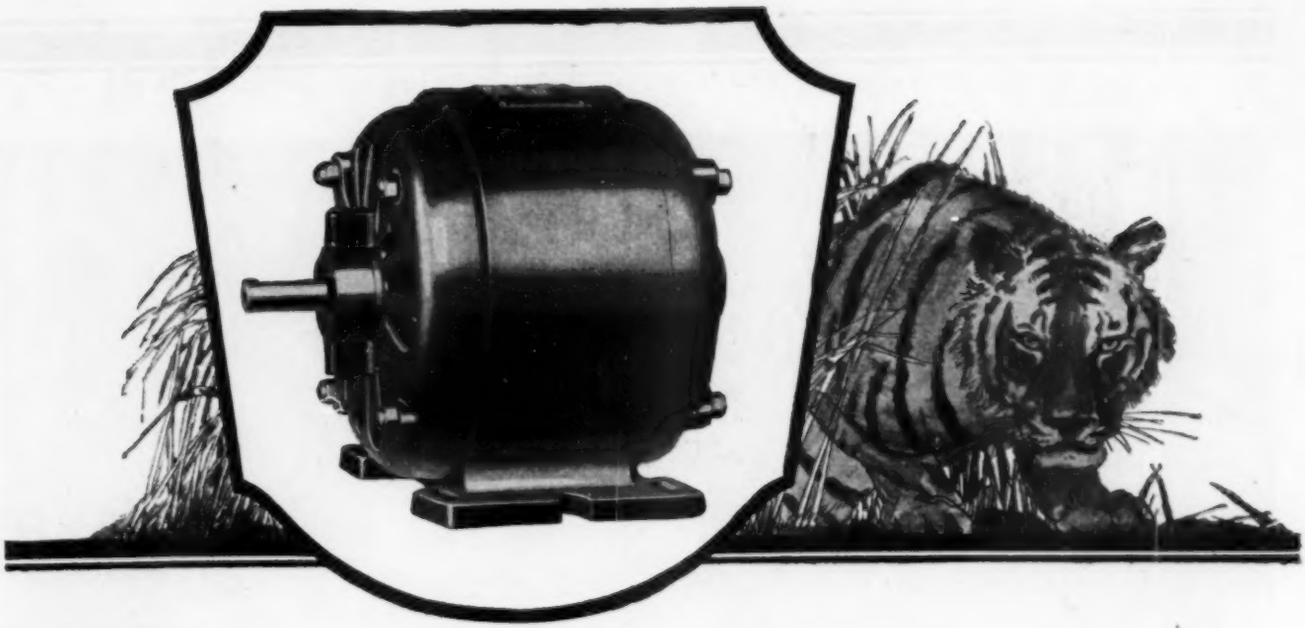
Save your workmen many miles of weary steps each day by installing "NEW BRITAIN" WORK STANDS. "Take the tools to the job." You expect mileage from your cars, not from your workmen. Ask for more "dope" on these handy, sturdy, economical work stands.

SEND FOR BULLETIN 2 S.F.

Other Units Made By This Company Include

Bench Legs—Single and Double
Smooth Top Steel Benches
Wood Top Benches
Combination Wood and Steel Top Benches
Portable Work Stands
Bench Drawers
Tote Boxes—Tote Box Racks
Machine Stands
Stock Racks
Work Stands—Portable and Stationary
Special Equipment to order
Shop Stools
Lathe Pans
Vise Stands
Revolving Screw Racks
Box Trucks
Die Trucks.

SHOP FURNITURE ORIGINATORS **THE NEW BRITAIN MACHINE CO.** NEW BRITAIN CONNECTICUT



Quiet Power - - -

OHIO Motors may be slightly higher in initial price than other motors on the market. It would not be difficult to lower that price but it would have to be done at the expense of workmanship, materials, inspection and test.

It is a fact that for many years Ohios have been standard equipment on many of the finest motor-driven machines and equipment. The Quiet Operation plus the Reliable Performance of these motors under even the most severe operating conditions is the reason, rather than price.

After all, the motor represents only a small fraction of the total cost of the complete equipment so the finest motor that can be built soon pays for any small difference in initial price in trouble-free service.

Send for detailed construction data and motor specifications.

Ohio Motors meet all N.E.M.A. and N.E.L.A. specifications.

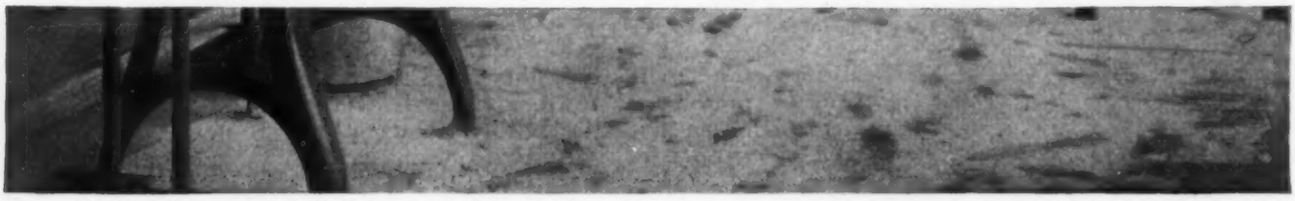
1/30 to 1 Horsepower.

The Ohio Electric Manufacturing Company
5903 Maurice Avenue, Cleveland, Ohio

OHIO reliable MOTORS

OHIO MOTORS

For Continuous Automatic Production in Brass and Steel



Brown & Sharpe Automatic Screw and Screw Threading Machines, especially when equipped with Automatic Rod Magazines, are offering some unusual production possibilities.

Increased spindle speeds and a greater range of speed changes makes possible the choice of the proper surface speed for threading without sacrificing the most efficient speeds for forming, turning and other operations.

On second operation work Brown & Sharpe Screw Machine Attachments, both stock and special, greatly simplify the handling of jobs ordinarily requiring two machines.

Our Screw Machine Service will gladly study your work with a view of recommending increased production possibilities through the use of Brown & Sharpe equipment.

Write for a copy of the No. 139 Catalog which lists our complete line of machines and attachments.

BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

If, in buying material handling equipment, its life, its cost of operation and the amount of work it will do are of importance to you, don't place a single order without investigating the Baker system of material handling by electric trucks, tractors and cranes. • We will welcome your comparison of Baker, *fact for fact*, with any other system of material handling. Long life, low operating cost and tremendous capacity are the very features which Baker Trucks were designed to supply.

Baker Industrial Truck Division

of THE BAKER-RAULANG COMPANY · *2164 West 25th St., Cleveland, Ohio*

Sales Offices in all principal cities

Canadian Representative: The Railway and Power Engineering Corporation, Ltd., Offices in Toronto, Montreal, Winnipeg, Vancouver

ELECTRIC TRACTORS AND TRUCKS

TRADE MARK

Baker

6 0 0

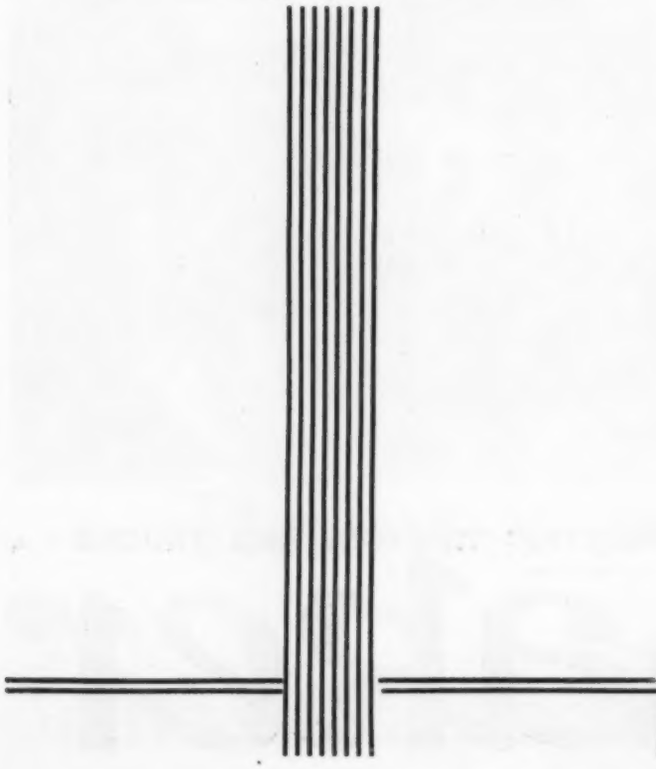
new types and designs of equipment will be described and illustrated in the 17th semi-annual

REVIEW NUMBER

July 16th

SIX HUNDRED new types and designs of equipment and machinery will be described and illustrated in the coming July 16th issue of *American Machinist*. This will be the Seventeenth Semi-Annual Review Number.

From no other source can executives, engineers and operating officials of the 12,000 machinery-building and metal-working plants served by *American Machinist* obtain this information in such complete and concise form. This highly informative review, published regularly at this time of year, is of inestimable value as a buying guide. You will want to refer to it again and again throughout the coming months . . whenever you are in the market for new equipment.



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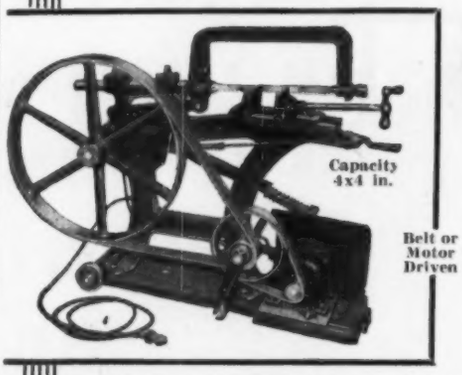

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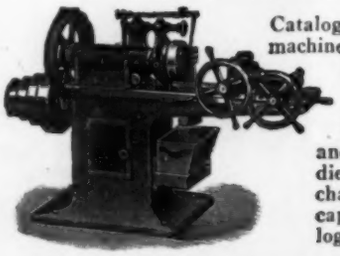

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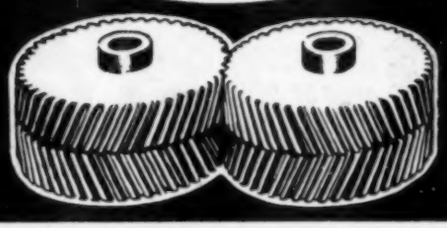

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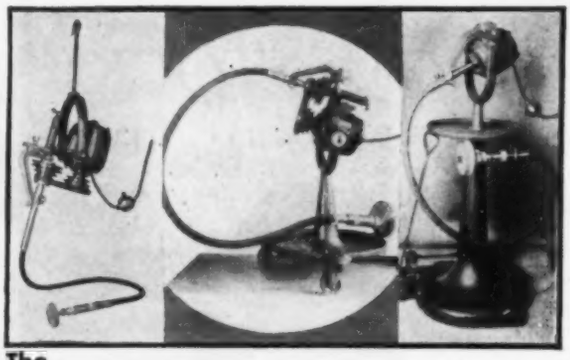

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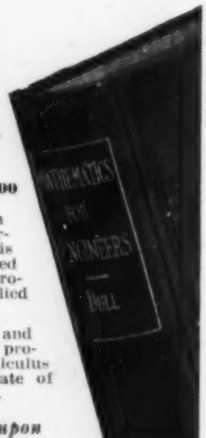

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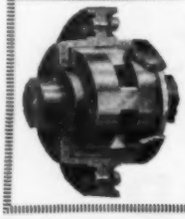

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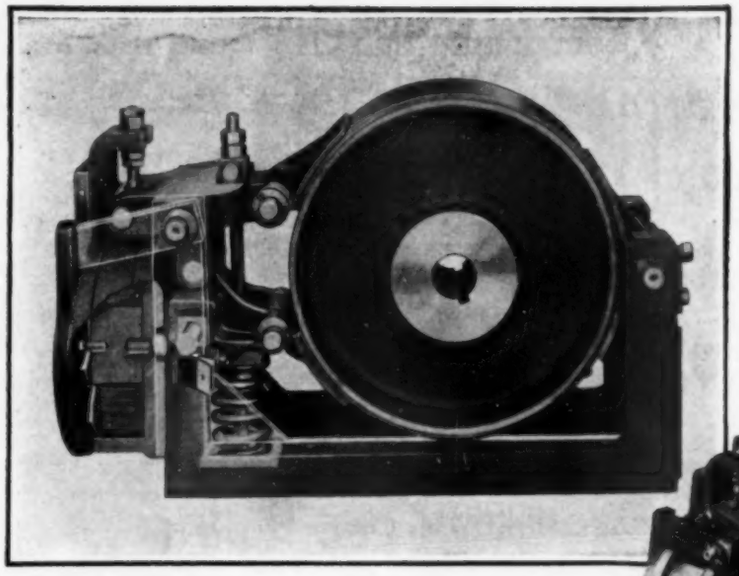

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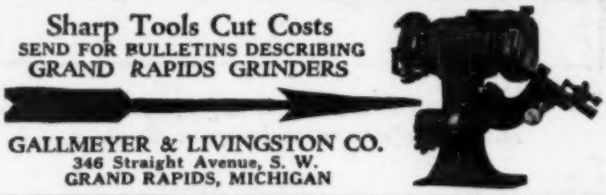

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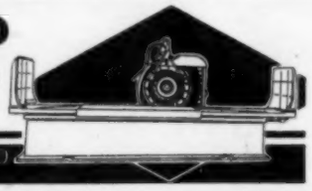

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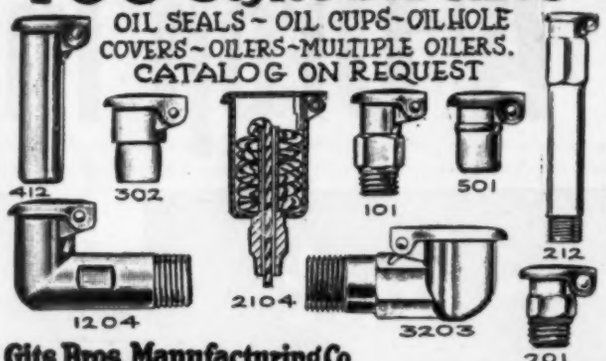

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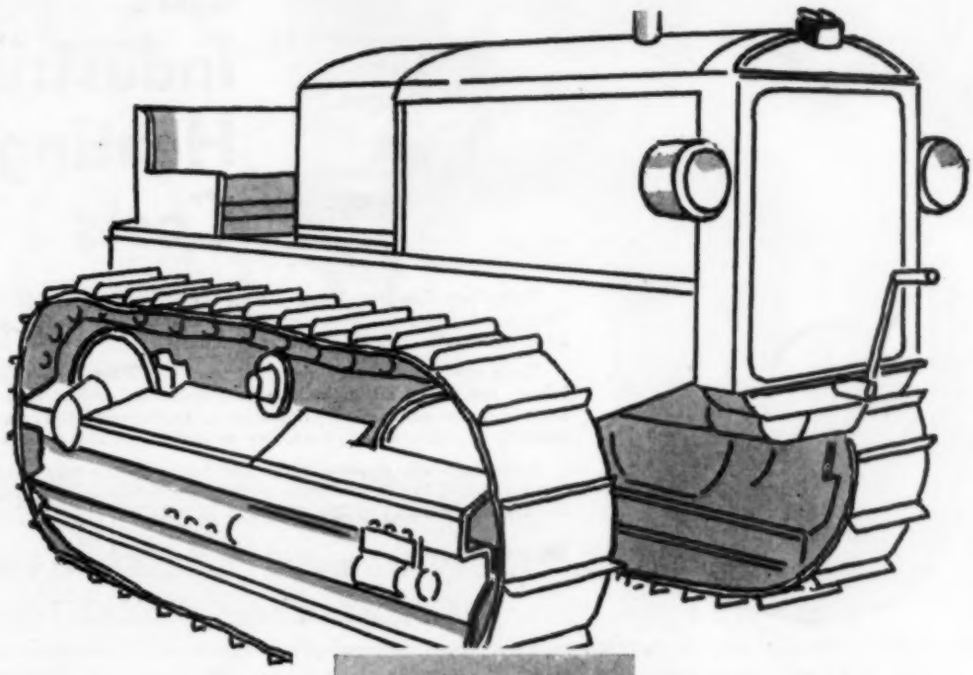
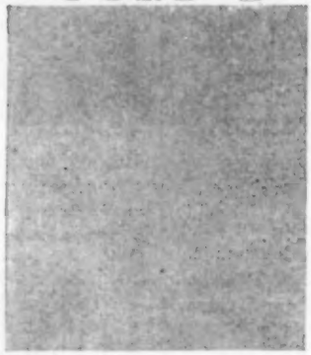


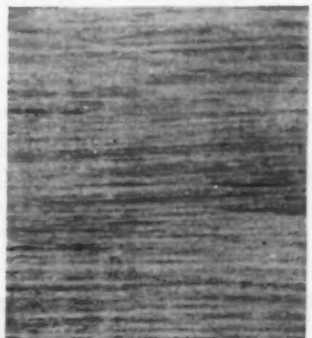
Painted with ordinary paints—YES. Protected with DULUX—No. Three year tests prove that Dulux is little affected by the sun's ultra-violet rays.

THE sun burns your skin through the medium of ultra-violet rays. With the same weapons it attacks paints. Oil and varnish type finishes hinder the passage of ultra-violet rays. Dulux does not. And that, strangely enough, is why Dulux is spared in the burning offensive. On du Pont paint farms and in actual service all over the country, Dulux was compared with the best of oil and varnish type finishes. Dulux retains its color, gloss, and protective film longer than paint and enamels, *50% to 100% longer* are the figures established by three years of testing.

Dulux gives a harder film than ordinary enamels, yet it is more flexible. It is far more resistant to marring and scratching. It is more impervious to moisture. And it resists the action of gasoline, acids, alcohol, and petroleum solvents. It may cut your finishing costs, too. It is classed next to Duco and lacquers for quick drying. It is applied by spray or brush, and can be baked or air dried.



Chalking pigment in Dulux oil 18 months' exposure at 45° South



Chalking pigment in Linseed oil 18 months' exposure at 45° South

The 45° southern exposure subjected these panels to the brunt of the sun's attack. In this test, equal quantities of a pigment of maximum chalking tendency were used in each vehicle.

Dulux has set up new finishing standards. And these standards have branded the oil and varnish type coatings obsolete. If you are using or considering the use of these older systems you should investigate this new du Pont development immediately. For full technical information, write E. I. du Pont de Nemours & Co., Inc., Industrial Finishes Division, Dept. PC6., Parlin, N. J., or 2100 Elston Ave., Chicago; Everett Station, Boston; 351 California St., San Francisco.

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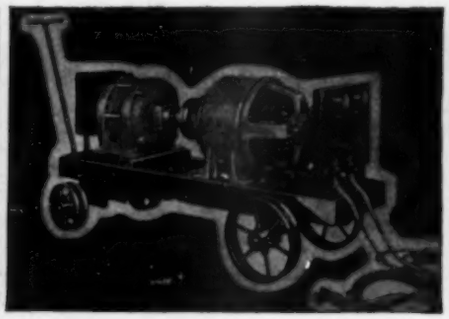

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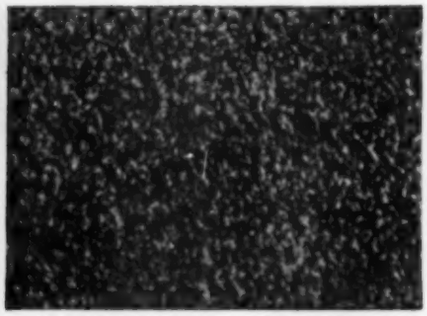

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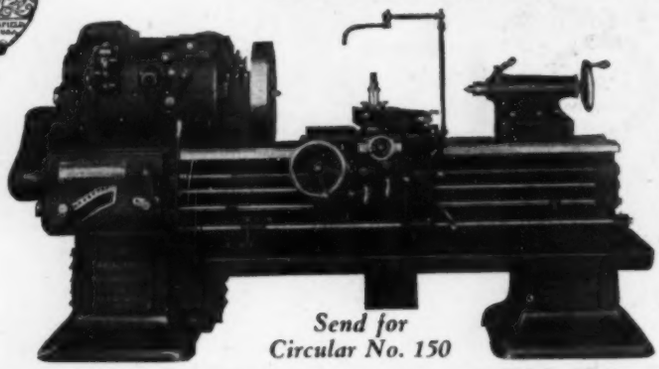

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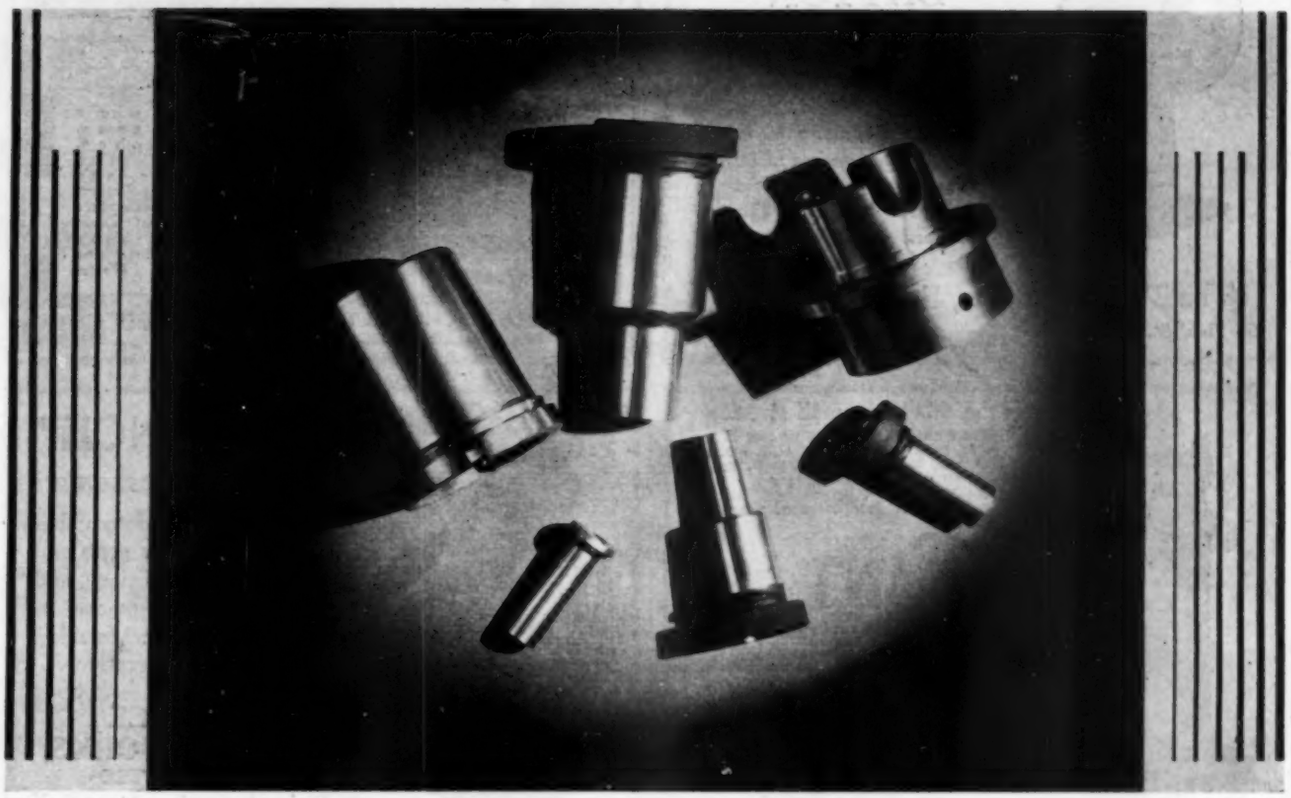

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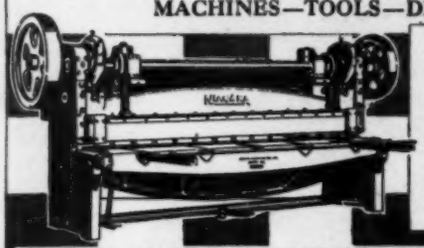

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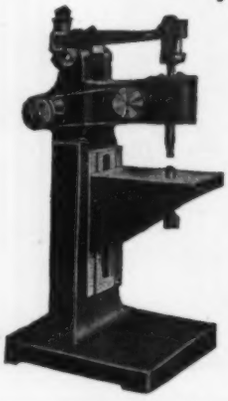

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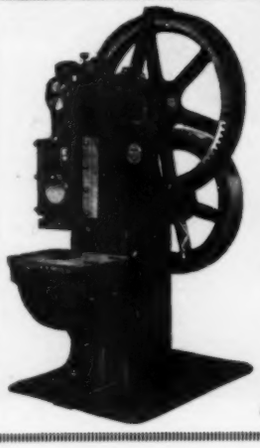

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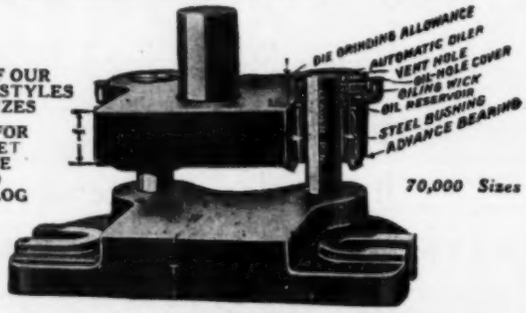

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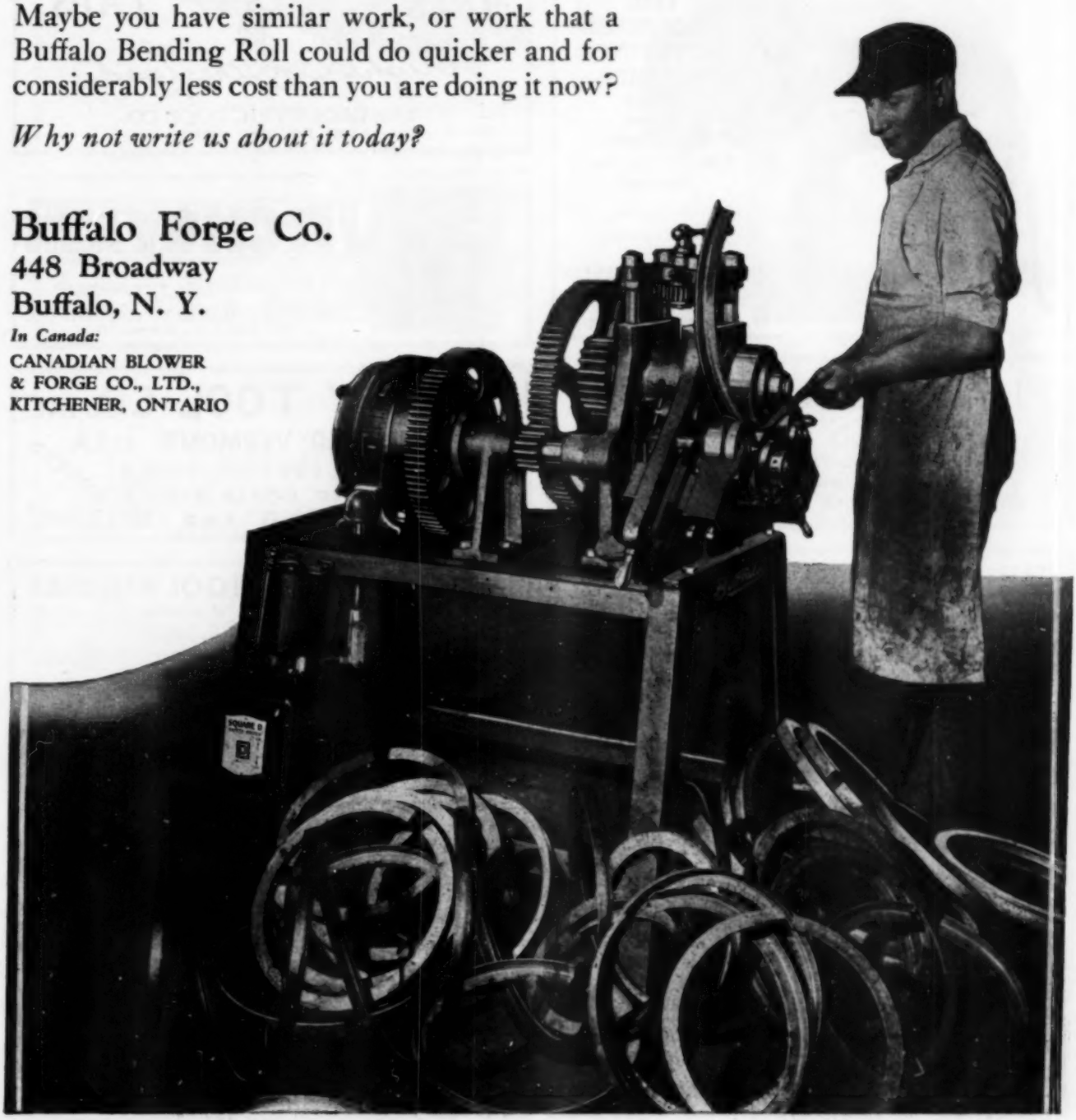

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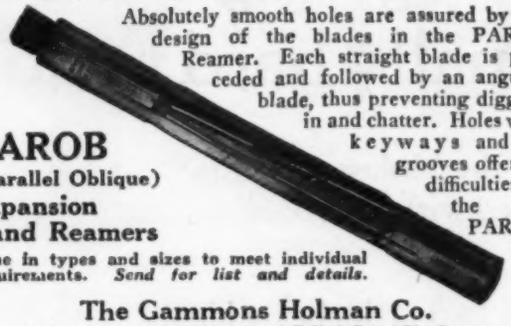

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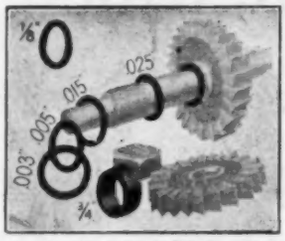

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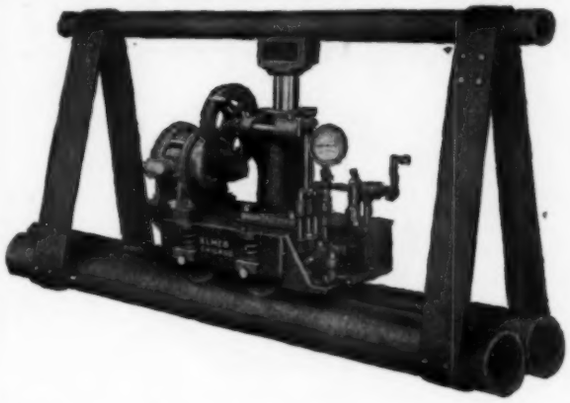

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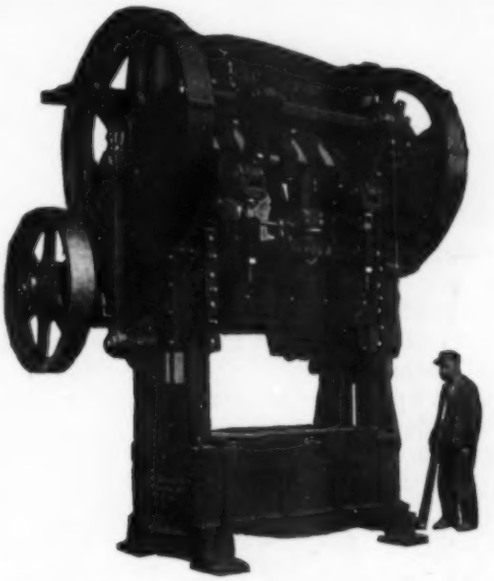

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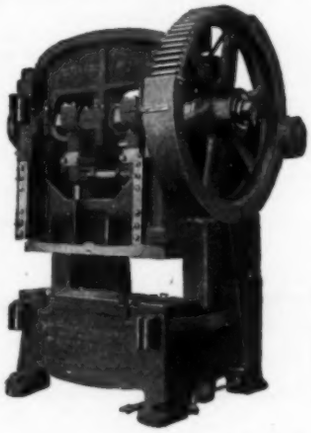

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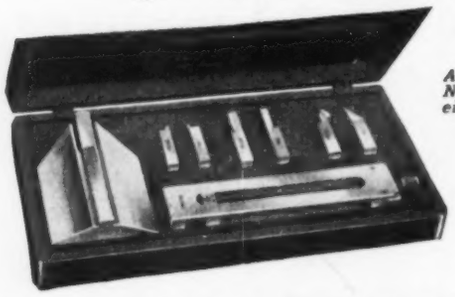

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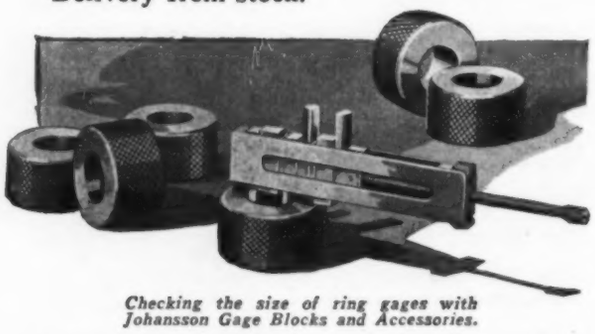

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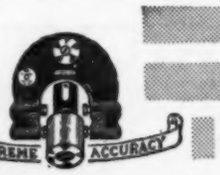

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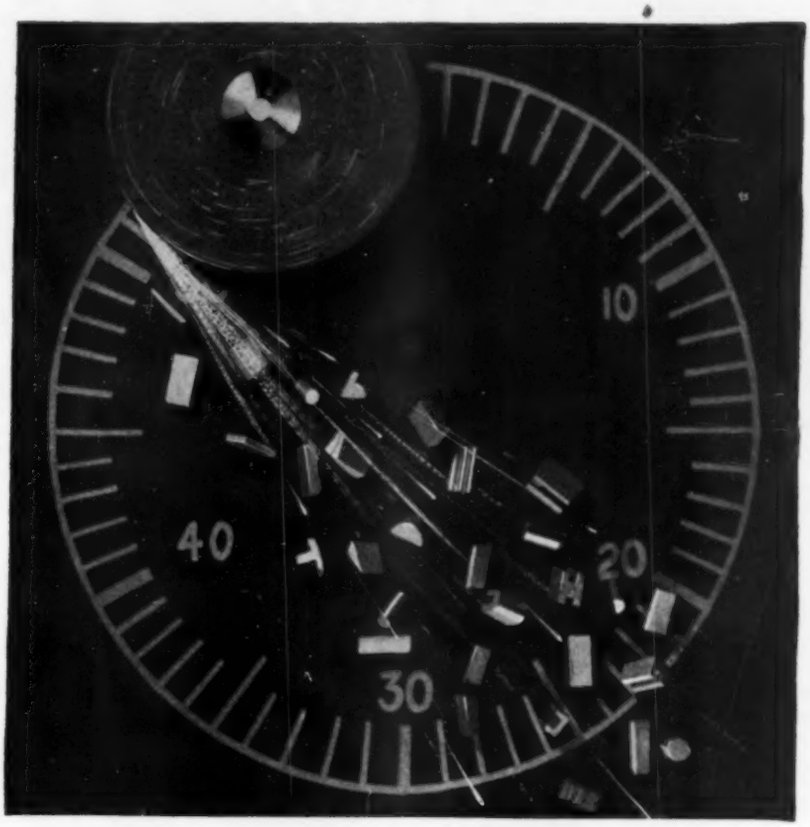

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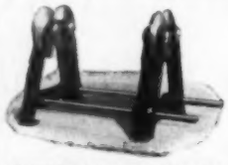

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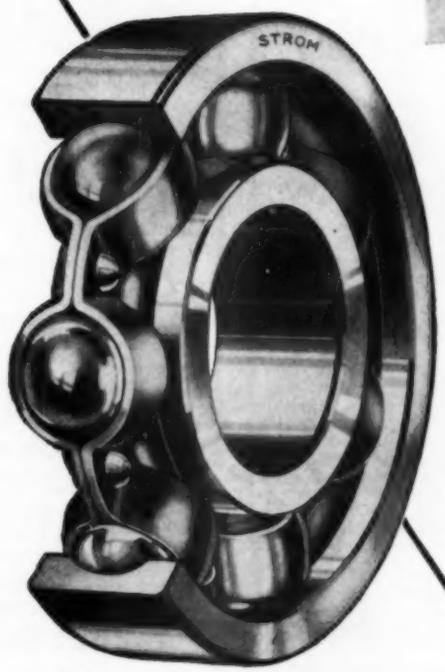

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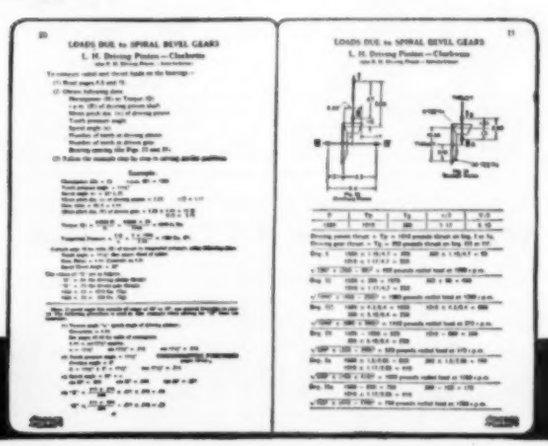
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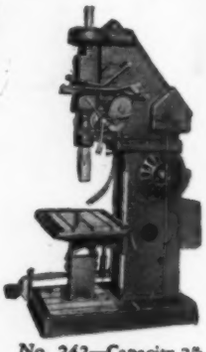

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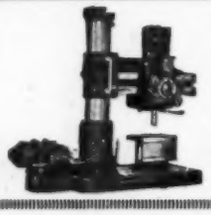

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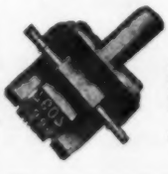

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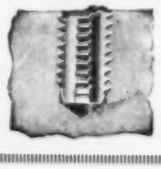

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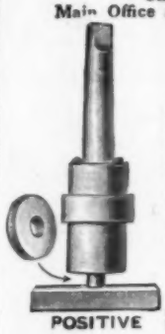

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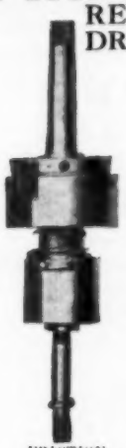

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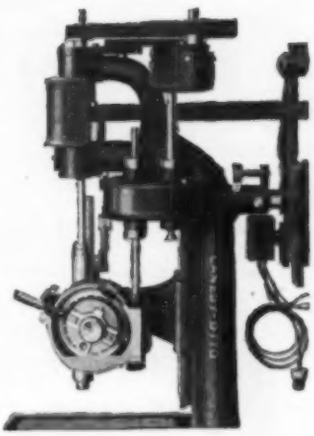

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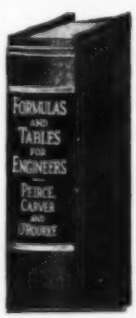

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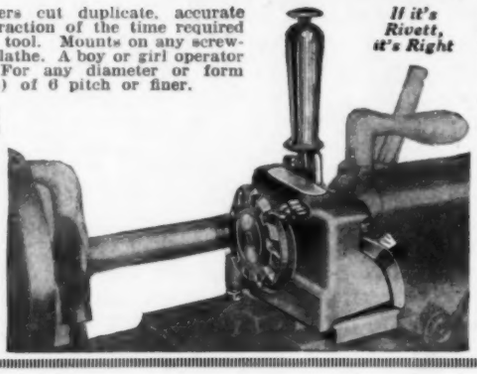

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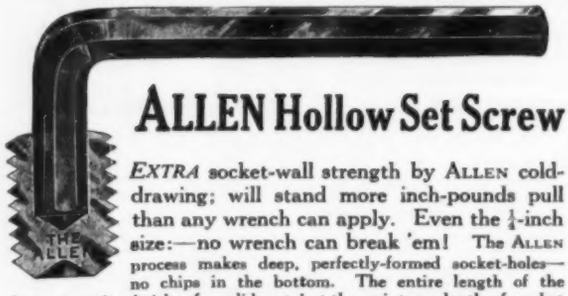

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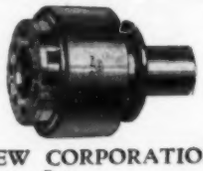

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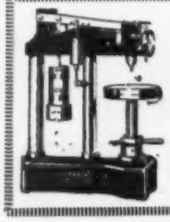

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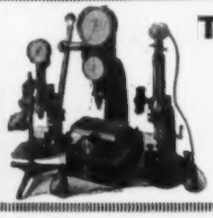

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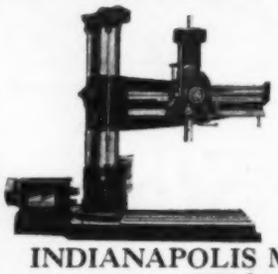

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Drill, 25 in. Kokomo, high speed
Grinders, 6 x 15 in. Fitchburg, 10 x 20 in. Landis
Grinder, 12 in. x 36 in. Cincinnati universal
Lathes 21 in. x 10 ft. LeBlond, heavy duty
Lathe, 18 in. x 10 ft. American quick change
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Miller, No. 2 Brown & Sharpe, heavy
Millers, No. 2 and No. 3 Kempsmith plain
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Presses, Nos. 1, 1½, 2 and 4 Robinson
Presses, New O.B.I. at low prices
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Shaper, 24 in. Rockford back geared
Shear, 5 ft. Robinson No. 362
Shear, No. 562 Niagara
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Taylor & Fenn Vertical Mill.
No. 2 LeBlond Plain Milling Machine.
14x6 Hendey Tool Room Lathe.
10x18 Norton B.A. Grinder.
10x36 Norton Plain Grinder.
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14—CINCINNATI No. 4, 3, 2, 2-M, 1.
17—BROWN & SHARPE No. 5-B, 4-B, 3-B, 2, 1, 0.
5—MILWAUKEE No. 3-B, 2-B, 1-B.
1—MILWAUKEE No. 2-B, Timken Bearing.
1—HENDEY No. 2-A.
1—BROWN & SHARPE No. 21.
3—KEMPSMITH No. 2, 1.
2—OESTERLINE No. 20.
7—BECKER No. 25.
3—CINCINNATI UNIVERSAL No. 4, 2, 2-M.
2—MILWAUKEE UNIVERSAL No. 2-B, 1-B.
1—KEMPSMITH UNIVERSAL No. 3.
11—BECKER VERTICAL No. 6, 5, 4-B, 1.
8—CINCINNATI VERTICAL No. 4, 3, 2.
2—BROWN & SHARPE VERTICAL No. 5, 3, 2.

MILLERS, MANUFACTURING
1—INGERSOLL SLAB 24"x24"x12'.
1—INGERSOLL 24"x24"x12', 2 Vertical Hds.
1—INGERSOLL 24"x12"x20', 2 Vertical Hds.
1—INGERSOLL SLAB 50"x20'.
1—INGERSOLL SLAB 48"x17½'.
1—NEWTON DUPLEX 54"x25"x11'.
1—NEWTON SLAB 36"x30"x7'.
1—BEAMAN & SMITH OPEN SIDE 18"x72".
1—BEAMAN & SMITH 3-spindle, 17"x120".
1—BEAMAN & SMITH DOUBLE END COLUMN FACER.
1—SUNDSTRAND RIGID No. 3.
3—BRIGGS MANUFACTURING Type B.
5—CINCINNATI AUTOMATIC 48", 24", 18".
8—KEMPSMITH No. 33, 60", 50", 36".

SHAPERS
1—COLUMBIA 28".
3—GOULD & EBERHARDT 24" Motor Drive.
1—STOCKBRIDGE 20".
1—GOULD & EBERHARDT 20" Motor Drive.
1—BARKER 16".
1—CINCINNATI 16", Motor Drive.

PLANERS
1—GRAY 72"x84"x12'.
1—CINCINNATI 72"x60"x10'.
1—NILES, BEMENT, POND 60"x48"x12".
2—CINCINNATI 56"x56"x16', 32'.
2—NILES, BEMENT, POND 48"x48"x16', 10'.
2—PUTNAM, 48"x48"x10', four heads.
1—GRAY 36"x36"x24', 12', four heads.
3—CINCINNATI 36"x36"x18'.
1—OHIO 36"x36"x16'.
1—NILES, BEMENT, POND 36"x36"x16'.
1—NILES, BEMENT, POND 30"x30"x14'.
1—GRAY 26"x26"x10'.
1—GRAY 24"x24"x12'.
2—GRAY 24"x24"x6'.
1—CINCINNATI 24"x24"x6'.

SEE TWO PRECEDING ISSUES FOR MACHINES NOT LISTED HERE

BORING MACHINES
2—UNIVERSAL, No. 3-A.
1—UNIVERSAL No. 24 Tri-Way.
1—CLEVELAND No. 1, 2⅛" Bar.
1—DEFIANCE No. 5, 3" Bar.
1—NILES, BEMENT, POND 5" Bar.
1—GIDDINGS & LEWIS No. 350, 3½" Bar.
2—BARNES No. 3 Horizontal Radial.
2—BARRETT No. 2, 2" Bar, No. 1, 3¾" Bar.
3—ROCKFORD, 2" Bar.
1—LUCAS No. 21 Horizontal.

GEAR CUTTERS
1—BROWN & SHARPE No. 5, 60".
3—BROWN & SHARPE No. 3, 26".
3—GOULD & EBERHARDT No. 36-H.
8—BARBER-COLMAN No. 12.
5—FELLOWS No. 6, No. 61.
2—SCHUCHARDT & SCHUTTE No. 2.
1—GOULD & EBERHARDT No. 36-BM.
1—GOULD & EBERHARDT 12"x24".
1—SCHUCHARDT & SCHUTTE No. 1.
2—GLEASON 18" Bevel.

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1,000-ton Bliss No. 27 embossing.
No. 59½ Toledo, wt. 80,000 lbs.
No. 67 Consolidated.
No. 165 Toledo toggle drawing.
No. 6 Adriance OBI.
50 other Presses, all styles.

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Nos. 2, 3 and 4 Cincinnati.
Nos. 2 and 3 LeBlond.
Nos. 1½, 2, 2B and 3 Brown & Sharpe.
Nos. 1½, 2 and 2½ Rockford.
No. 3 Kempsmith.

Lathes

12-in.x6-ft., 14-in.x6-ft., 14-in.x8-ft. and 18-in.x8-ft. Hendey.
14-in.x6-ft., 16-in.x6-ft., 16-in.x8-ft., 18-in.x8-ft. and 20-in.x8-ft. Cisco geared head.
12-in.x6-ft., 14-in.x6-ft. and 17-in.x6-ft. LeBlond.
20-in.x8-ft. Lodge & Shipley.
22-in.x10-ft. Davis.
24-in.x12-ft. Milwaukee.
26-in.x13-ft. Wickes.
27-in.x12-ft. Schumacher Boye & Emmes.

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MACHINERY COMPANY
SAGINAW, W. S.
MICHIGAN

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1—BULLARD 42-in. New Era.
1—BULLARD 42-in.—2 heads.
1—BETTS 8-ft. Ver.
1—BETTS 10-ft. Ver.
1—BEMENT MILES 10-16-ft. extension Ver.
1—NILES 10-16-ft. extension Ver.
1—ROCKFORD No. 2 hor. 3⅛-in. bar.
1—LANDIS No. 35—3½-in. bar. horiz.
1—N.-B.-P. 4-in. bar table type, horiz.
1—BARRETT No. 2—5-in. bar horiz.
1—SELLERS 72 Vert.

MILLING MACHINES
6—B.&S. Nos. 2, 2B Pl.
8—Cin. Nos. 1½, 2, 3, 4 Pl.
2—CLEVELAND No. 1 and 2 Univ.
1—CINCINNATI No. 2 Univ.
1—LEBLOND No. 3 Univ.
3—BECKER Nos. A, B, C, 6 Ver.
2—CINCINNATI No. 3 and No. 4 Ver.
1—TAYLOR & FENN Ver.
8—BRIGGS Type "A" Mfg.
1—INGERSOLL 24x24-in.x16-ft. adj. rail.
1—INGERSOLL 24x24-in.x10-ft.
2—P.&W. 5-in., 12-in. Mfg.
6—P. & W. 4½x12, 6x14, 6x48, 6x80 thread.

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4—BAUSH No. 1, 2 round and rect. hds.
6—NATCO Nos. 12, 13, 14, 30 and 37 round and rect. hds.
1—MOLINE No. 5-D Cyl. Borer.

DRILLS—Radial
1—AMERICAN 2½-ft. Pl. SPD.
2—CINCINNATI-BICKFORD 3-ft. SPD.
1—AMERICAN 3-ft. Triple geared.
1—AMERICAN 3-ft. triple purp. SPD.
1—AMERICAN 4-ft. plain, spd.
1—AMERICAN 5-ft. triple purpose.
1—HAMMOND 4-ft. Pl.
2—CINCINNATI-BICKFORD 4-ft. and 6-ft. univ.

GEAR CUTTERS
6—BARBER-COLMAN No. 12.
7—LEES-BRADNER No. 5-A.
3—FELLOWS Gear Grinders.
8—FELLOWS Nos. 6, 61, 65, 615.
4—FELLOWS Nos. 7, high speed.
3—GLEASON 6-in., 11-in., 18-in.
1—GLEASON 25-in., 2-tool bevel gear.
1—SCHUCHART & SCHUTTE (Pfauter) No. 2, 20-in. cap.

LATHES
3—HENDEY 14-in.x6-ft., 16-in.x6-ft., 16-in.x8-ft. grd. hd.
2—SEBASTIAN 18-in.x5-ft.
2—SPRINGFIELD 18-in.x10-ft.
2—REED-PRENTICE 20-in.x10-ft. spd.
1—REED-PRENTICE 24-in.x12-ft.

TURRET AND SCREW MACHINES
2—ACME 3¼x36.
10—J. & L. 2¼x24, 3x36.
1—W. & S. No. 4 Univ. SPD.
3—W. & S. No. 3A Univ.

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24-in. **G & E Shaper.**
No. 3 **Cincinnati Univ. Miller.**

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Lathe, Monarch 12 x 4 DBG. QCG.
Miller, Hendey No. 8 Improved—Lincoln type
Press, Niagara No. 2 Flywheel 1 ½" stroke
Shaper, Hendey friction 15"
Shaper, Potter & Johnston 15" universal
Turret Lathe, Warner & Swasey 14" C/S

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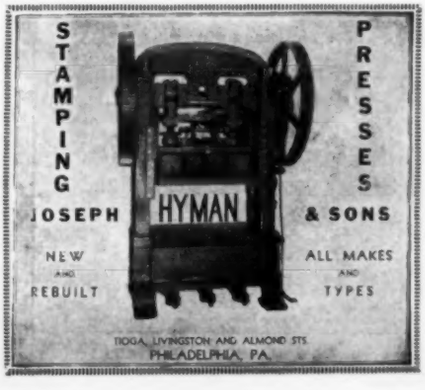

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Machinery Wanted
Mining Equipment For Sale
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Positions Vacant
Positions Wanted
Receivers' Sales
Representatives Wanted
Salesmen Available
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GN-036

WHAT AND WHERE TO BUY

A Classified Index of Advertisers in This Issue

This index is published as a convenience to the reader. Every care is taken to make it accurate, but *American Machinist* assumes no responsibility for errors or omissions.

For Alphabetical Index See Last Page

ACCUMULATORS, Hydraulic
Elmes Eng. Wks., Chas. F.
Watson-Stillman Co.

AIR Cushions for Power Presses
Marquette Tool & Mfg. Co.

ANGLE Plates Universal
United States Automatic Box Machy. Co.

ARBORS and Mandrels
Brown & Sharpe Mfg. Co.
Cincinnati Mill. Mach. Co.
Nicholson & Co.
Sundstrand Mach. Tool Co.
Union Twist Drill Co.

BABBITT, Metal
Westinghouse Elec. & Mfg. Co.

BALANCING Ways
Anderson Bros. Mfg. Co.
Sundstrand Mach. Tool Co.

BALLS, Brass, Bronze and Steel
Hartford Steel Ball Co.
New Departure Mfg. Co.

BARRELS, Burnishing and Tumbling
Hartford Steel Ball Co.

BEARINGS, Ball
Federal Bearings Co.
New Departure Mfg. Co.
Norma Hoffman Bearings Corp.
Strom• Bearing Co.

BEARINGS, Roller
Norma Hoffman Bearings Corp.
Timken Roller Bearing Co.

BEARINGS, Thrust
Norma Hoffman Bearings Corp.
Timken Roller Bearing Co.

BELT Shifters
Haskins, R. G. Co.

BENCHES and Bench Legs
New Britain Bridley Mch. Co.
Standard Pressed Steel Co.

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Buffalo Forge Co.
Consolidated Mach. Tool Corp. of America
Elmes Eng. Wks., Chas. F.
Watson-Stillman Co.
Wickes Bros.

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American Gas Furnace Co.
Buffalo Forge Co.
Chicago Flexible Shaft Co.

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Wickes Bros.

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Acme Mchy. Co.
Foote-Burt Co.
Landis Mach. Co.
National Acme Co.
National Machinery Co.

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Consolidated Mach. Tool Corp. of America
Sellers & Co., Wm.

BORING Bars and Heads
Lovejoy Tool Co., Inc.

BORING, Drilling and Milling Machines, Horizontal
Barnes Co., W. F. & John
Consolidated Mach. Tool Corp. of America
Moline Tool Co.
Rockford Drill. Mach. Co.
Ryerson & Son, Jos. T.
Sellers & Co., Wm.
Springfield Mch. Tool Co.

BORING, Drilling and Milling Machines, Vertical
Ferner Co., R. Y.
Sellers & Co., Wm.
Universal Boring Mach. Co.

BORING Machines, Car Wheel
Sellers & Co., Wm.

BORING Machines, Locomotive Driving Box
Sellers & Co., Wm.

BORING Tools
Armstrong Bros. Tool Co.
Lovejoy Tool Co., Inc.

BRAKES, Magnetic
Westinghouse Elec. & Mfg. Co.

BROACHING Machines
Perkins Mach. & Gear Co.

BURNERS, Oil and Gas
Hones, Chas. A.
Johnson Gas Appliance Co.

BUSHINGS, Drill and Jig
Acme Industrial Co.

CALIPERS
Brown & Sharpe Mfg. Co.
Slocomb Co., J. T.
Starrett Co., L. S.

CAMS
Hartford Special Machy. Co.

CARBURIZING Machines
American Gas Furnace Co.

CASE Hardening and Tempering Compounds
Meisel Press Mfg. Co.
Shore Instrument & Mfg. Co.

CASTINGS, Iron and Semi-Steel
Springfield Mach. Tool Co.
Superior Charcoal Iron Co.

CENTERING Machines
Hanson-Whitney Mach. Co.
Pratt & Whitney Co.
Sundstrand Mach. Tool Co.

CHAINS, Transmission
Baldwin Duckworth Chain Corp.
Boston Gear Works Sales Co.
Philadelphia Gear Wks.

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Noble & Westbrook Mfg. Co.

CHUCKING Machines
Bullard Co.
Cleveland Auto. Mach. Co.
Goss & deLeeuw Mach. Co.
Jones & Lamson Mach. Co.
Kingsbury Mach. Tool Corp.
National Acme Co.
New Britain Gridley Mch. Co.
Potter & Johnston Mach. Co.

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Errington Mech. Laboratory
Ettco Tool Co.
Geometric Tool Co.
National Tool Co.

CHUCKS, Collet
Sundstrand Machine Tool Co.

CHUCKS, Drill and Tap
Errington Mech. Laboratory
Ettco Tool Co.

CHUCKS, Full Floating
Errington Mech. Laboratory

CHUCKS, Lathe
Bullard Co.

CHUCKS, Magnetic
Heald Machine Co.

CHUCKS, Vertical Boring Mill
Bullard Co.

CLAMPS, Machinists'
Armstrong Bros. Tool Co.
Starrett Co., L. S.

CLEANERS, Compounds
Oakite Products, Inc.

CLEANING Machines, Metal Parts
Colts Pat. Fire Arms Mfg. Co.

CLUTCHES, Friction
Brown Eng. Co.
Johnson, Carlyle Machine Co.
Raybestos Manhattan Inc.

COLLARS, Spacing
Detroit Stamp. Co.

COLLETS
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Geometric Tool Co.
Hardinge Bros.
Rivett Lathe & Grinder Corp.
Union Twist Drill Co.

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Oakite Products

COMPOUNDS, Resin
Bakelite Corp.

CONTRACT Work
American Metal Treat. Co.
Brown & Sharpe Mfg. Co.
Bunell Mach. & Tool Co.
Columbus Die T. & M. Co.
Detroit (Mich.) Stamp. Co.
Hartford Special Machy. Co.
Johnson Machine Co., Carlyle
Langelier Mfg. Co.
Lincoln Mach. Co.
Meisel Press Mfg. Co.
Moore Special Tool Co.
Nicholson & Co., W. H.
Precison Engr. Co.•
Standard Pressed Steel Co.
U. S. Tool Co.
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National Tool Co.

COUNTERSHAFTS
Rivett Lathe & Grinder Corp.
Standard Pressed Steel Co.

COUNTERS and Counting Machines
Veeder-Root

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Boston Gear Wks. Sales Co.
Brown Eng. Co.
Nicholson & Co., W. H.
Philadelphia Gear Wks.

CUTTERS, Gear
Brown & Sharpe Mfg. Co.
Union Twist Drill Co.

CUTTERS, Keyseater
Davis Keyseater Co.

CUTTERS, Milling
Barber-Colman Co.
Brown & Sharpe Mfg. Co.
Geometric Tool Co.
Ingersoll Milling Mach. Co.
Kearney & Trecker Corp.
Lovejoy Tool Co., Inc.
Pratt & Whitney Co.
Union Twist Drill Co.

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Brown & Sharpe Mfg. Co.
Cincinnati Elec. Tool Co.
Landis Mach. Co.

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Essley Mchy. Co., E. L.
Freeman & Co., Samuel T.
General Mchy. Corp.
Hill Clarke & Co.
Hyman & Sons, J.
Indianapolis Mchy. Co.
Miles Machy. Co.
Morey & Co., Inc.
Osborne & Sexton Mhy. Co.
Palmer-Edwards Co.
Simmons Mach. Tool Corp.

DIE Cushions, Pneumatic
Marquette Tool & Mfg. Co.

DIE Cutting Machines
Gorton Mach. Co., Geo.
Keller Mech. Engr. Corp.
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DIE Holders for Presses
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DIEING Machines
Henry & Wright Mfg. Co.

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Haskins, R. G. Co.
Keller Mech. Engr. Corp.
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DIE Sets
Baumbach Mfg. Co., E. A.
Danly Mach. Spec., Inc.
U. S. Tool Co.

DIES, Adjustable, Self Opening
Eastern Mach. S. Corp.
Errington Mech. Laboratory
Geometric Tool Co.
Jones & Lamson Mach. Co.
Landis Mach. Co.
Murchey Mach. & Tool Co.
National Acme Co.
National Machy. Co.

DIES, Forging
Keller Mech. Engr. Corp.

DIES, Sheet and Sub Press (See Contract Work)

DIES, Steel Marking
Noble & Westbrook Mfg. Co.

DOGS, Lathe and Milling Machine
Armstrong Bros. Tool Co.

DOWEL Pins
E. A. Baumbach Mfg. Co.

DRESSERS, Grinding Wheel
Desmond-Stephen Mfg. Co.
Norton Co.

DRILL and Tap Heads, Multiple
Errington Mech. Laboratory
Hoefer Mfg. Co.
U. S. Drill Head Co.

DRILLING Machines, Automatic and Semi-Automatic
Baker Bros.
Barnes Drill Co.
Kingsbury Machine Tool Corp.
Rockford Drilling Machine Co.
Sundstrand Mach. Tool Co.

DRILLING Machines, Bench
Barnes Co., W. F. and John
Canedy-Otto Mfg. Co.
Cincinnati Electrical Tool Co.
Rockford Drilling Mach. Co.
United States Automatic Box Machy. Co.
U. S. Elec. Tool Co.

DRILLING Machines, Gang
Baker Bros.
Barnes Co., W. F. and John
Barnes Drill Co.
Foote-Burt Co.
Henry & Wright Mfg. Co.
Rockford Drilling Mach. Co.

DRILLING Machines, Heavy Duty
Barnes Co., W. F. and John
Barnes Drill Co., Inc.
Consolidated Mach. Tool Corp. of America
Foote-Burt Co.
Minster Machine Co.
Rockford Drilling Mach. Co.

DRILLING Machines, Horizontal (See Boring, Drilling and Milling Machines, Horizontal)
Baker Bros.

DRILLING Machines, Horizontal, One Way
Kingsbury Machine Tool Corp.

DRILLING Machines, Radial
American Tool Works Co.
Carlton Machine Tool Co.
Morris Mach. Tool Co.
Ryerson & Son, Jos. T.
Sellers & Co., Wm.

DRILLING Machines, Sensitive
Barnes Co., W. F. and John
Buffalo Forge Co.
Canedy-Otto Mfg. Co.
Hardinge Bros.
Henry & Wright Mfg. Co.
High Speed Hammer Co.
Kingsbury Mach. Tool Corp.
Langelier Mfg. Co.
Leland-Gifford Co.
Taylor & Fenn Co.
United States Automatic Box Machy. Co.

DRILLING Machines, Turret
Kingsbury Mach. Tool Corp.

DRILLING, Machines, Upright Multiple Spindle
Baker Bros.
Barnes Co., W. F. and John
Barnes Drill Co.
Buffalo Forge Co.
Consolidated Mach. Tool Corp. of America
Foote-Burt Co.
Grant Mfg. & Mach. Co.
Henry & Wright Mfg. Co.
Kingsbury Mach. Tool Corp.
Moline Tool Co.
Pratt & Whitney Co.
Rockford Drilling Mach. Co.
Sellers & Co., Wm.

DRILLING Machines, Vertical
Barnes Co., W. F. & John
Barnes Drill Co., Inc.
Canedy-Otto Mfg. Co.
Foote-Burt Co.
Leland-Gifford Co.
Rockford Drilling Mach. Co.

DRILL Machine Head
U. S. Drill Head Co.

DRILLS, Center
Union Twist Drill Co.

DRILLS, Portable, Elec. and Pneumatic (See Portable Tools)
Cincinnati Electrical Tool Co.
U. S. Elec. Tool Co.

DRILLS, Ratchet
Armstrong Bros. Tool Co.
Union Twist Drill Co.

DRILLS, Twist and Flat
Union Twist Drill Co.

ELEC. Instruments
Westinghouse Elec. & Mfg. Co.

ELEC. Supplies
Westinghouse Elec. & Mfg. Co.

ENGRAVING Machinery
Gorton Mach. Co., Geo.
Preis & Co., H. P.

EXTRACTORS, Oil
Barrett, Leon J.

FANS, Electric
Buffalo Forge Co.
Westinghouse Elec. & Mfg. Co.

FILING Machines
Haskins, R. G. Co.
Oliver Instrument Co.

FITTINGS, Hydraulic
Elmes Eng. Works, Chas. F.
Watson-Stillman Co.

FLEXIBLE Shaft Equipment
Keller Mech. Engr. Corp.
Strand & Co., N. A.

FORGING Machinery
Acme Mchy. Co.
National Mchy. Co.

FORMING Attachment, Press
Marquette Tool & Mfg. Co.

FURNACES, Electric
Strong, Carlisle & Hammond Co.
Westinghouse Elec. & Mfg. Co.

FURNACES, Forging
American Gas Furnace Co.
Chicago Flexible Shaft Co.
Hones, Chas. A.
Strong, Carlisle & Hammond Co.
Westinghouse Elec. & Mfg. Co.

FURNACES, Heat Treating, Tempering and Annealing
American Gas Furnace Co.
Chicago Flexible Shaft Co.
Johnson Gas Appliance Co.
Strong, Carlisle & Hammond Co.
Westinghouse Elec. & Mfg. Co.

FURNACES, Oil and Gas
Johnson Gas Appliance Co.
Strong, Carlisle & Hammond Co.

FURNACES, Soldering
Hones, Chas. A.

FURNITURE, Machine Shop
Brown Eng. Co.
New Britain Gridley Mch. Co.

GAGE Blocks
C. E. Johnsson, Inc.
Standard Gage Co., Inc.

GAGES, Comparators
Federal Products Corp.
Jones & Lamson Mch. Co.

GAGES, Dial
Federal Products Corp.
Standard Gage Co., Inc.
Starrett Co., L. S.

GAGES, Plug and Ring
Brown & Sharpe Mfg. Co.
Hanson-Whitney Machine Co.
Pratt & Whitney Co.
Standard Gage Co., Inc.
Taylor Instrument Co.

GAGES, Snap, Thread and Cylindrical
Brown & Sharpe Mfg. Co.
Federal Products Corp.
Hanson-Whitney Machine Co.
C. E. Johnsson, Inc.
Pratt & Whitney Co.
Standard Gage Co., Inc.

GAGES, Standard
Federal Products Corp.
Hanson-Whitney Mach. Co.
C. E. Johnsson, Inc.
Standard Gage Co., Inc.

GEAR Blanks
Bakelite Corp.

GEAR Burnishing Machines
Gleason Works

GEAR Cutting Machinery
Adams Co.
Barber-Colman Co.
Bilgram Machine Works
Brown & Sharpe Mfg. Co.
Fellows Gear Shaper Co.
Gleason Works
Waltham Machine Works

GEAR Tempering Machinery
Gleason Works

GEAR Testing Machinery
Ferner Co., R. Y.
Gleason Works

GEARS, Cast
Cleveland Worm & Gear Co.
Grant Gear Works
Hartford Special Machy Co.
Philadelphia Gear Works

GEARS, Cut
Adams Co.
Bilgram Machine Works
Boston Gear Wks. Sales Co.
Brown & Sharpe Mfg. Co.
Cleveland Worm & Gear Co.
Diefendorf Gear Corp.
Earle Gear & Mch. Co.
Fellows Gear Shaper Co.
Gleason Works
Grant Gear Works
Hartford Special Machy. Co
Johnson Machine Co., Carlyle
Meisel Press Mfg. Co.
Philadelphia Gear Works
Simonds Mfg. Co.

GREASE Guns
Alemite Mfg. Corp.

GRINDING Machines, Bench
Cincinnati Electrical Tool Co.
Haskins, R. G. Co.
Norton Co.
Union Twist Drill Co.

GRINDING Machines Centerless
Cincinnati Grinders, Inc.

GRINDING Machines, Chaser
Geometric Tool Co.
Landis Mach. Co.
National Acme Co.

GRINDING Machines, Chucking
Bryant Chucking Grinder Co.
Heald Machine Co.

GRINDING Machines, Cutter and Tool
Barber-Colman Co.
Barnes Co., W. F. & John
Brown & Sharpe Mfg. Co.
Bryant Chucking Grinder Co.
Cincinnati Milling Mach. Co.
Gallmeyer & Livingston Co.
Gorton Mach. Co., Geo.
Heald Mach. Co.
LeBlond Mach. Tool Co., R. K.
Norton Co.
Oliver Instrument Co.
Sellers & Co., Wm.
Taylor & Fenn Co.
Union Twist Drill Co.

GRINDING Machines, Cylinder
Bryant Chucking Grinder Co.
Heald Machine Co.
Micro Machine Co.
Norton Co.

GRINDING Machines, Cylindrical
Brown & Sharpe Mfg. Co.
Cincinnati Grinders Co.
Heald Machine Co.

GRINDING Machines, Die
Abrasive Mch. Tool Co.
Bryant Chucking Grinder Co.
Geometric Tool Co.
Heald Machine Co.
Landis Machine Co.
Murchey Mach. & Tool Co.
National Machinery Co.

GRINDING Machines, Face or Ring Wheel
Abrasive Mch. Tool Co.
Diamond Mach. Co.

GRINDING Machines, Flexible Shaft
Haskins, R. G. Co.
Keller Mech. Engr. Co.

GRINDING Machines, Floor, no feed attachments
Brown & Sharpe Mfg. Co.
Cincinnati Electrical Tool Co.
Diamond Mach. Co.
Norton Co.

GRINDING Machines, Gage
Abrasive Mch. Tool Co.
Ferner Co., R. Y.

GRINDING Machines, Internal
Bryant Chucking Grinder Co.
Cincinnati Grinders
Heald Mach. Co.
Hjorth Lathe & Tool Co
Hutto Engr. Co.
Micro Machine Co.
Rivett Lathe & Grinder Corp.

GRINDING Machines, Piston Ring
Heald Machine Co.

GRINDING Machines, Portable
Cincinnati Electrical Tool Co.
Haskins, R. G. Co.

GRINDING Machines, Surface
Abrasive Mch. Tool Co.
Brown & Sharpe Mfg. Co.
Diamond Mach. Co.
Gallmeyer & Livingston Co.
Heald Mach. Co.
Norton Co.
Pratt & Whitney Co.

GRINDING Machines, Swing Frames or Snagging
Blount Co., J. G.
Cincinnati Electrical Tool Co.
Diamond Mach. Co.
Norton Co.

GRINDING Machines, Universal
Brown & Sharpe Mfg. Co.
Cincinnati Grinders
Gallmeyer & Livingston Co.
LeBlond Mach. Tool Co., R. K.
Norton Co.

GRINDING Wheels
Norton Co.

HAMMERS, Power
Bliss Co., E. W.
High Speed Hammer Co.
Sellers & Co., Wm.

HANGERS, Shaft
Standard Pressed Steel Co.

HARDNESS Measuring Instruments, Steel
Shore Instrument & Mfg. Co
Wilson-Maeulen Co.

HEATERS, Rivet
American Gas Furnace Co.
Buffalo Forge Co.

HEATING Equipment, Gas
General Gas Light Co.

HOBBING Machines
Adams Co.
Barber-Colman Co.
Brown & Sharpe Mfg. Co.

HOBS
Barber-Colman Co.
Brown & Sharpe Mfg. Co.
Hanson-Whitney Machine Co.
National Tool Co.
Philadelphia Gear Works
Union Twist Drill Co.

HONING Machines
Barnes Drill Co.
Hutto Engr. Co.

HYDRAULIC Machinery
Elmes Eng. Works, Chas. F.
Watson-Stillman Co.

INDICATORS, Dial
Federal Products Corp.
Standard Gage Co., Inc.

INDICATORS, Speed and Test
Brown & Sharpe Mfg. Co.
Starrett Co., L. S.
Superior Charcoal Iron Co.
Veeder-Root

JACKS, Planer
Armstrong Bros. Tool Co.

JIGS and Fixtures
(See Contract Work)

JOINTS, Universal
Boston Gear Wks. Sales Co.

KEYSEATING Machines
Baker Bros.
Davis Keyseater Co.

LAMPS, Elec.
Westinghouse Elec. & Mfg. Co.

LAPPING Machines, Cylindrical and Flat
Norton Co.

LATHE Attachments
Flather Co. (The)
South Bend Lathe Works

LATHE Tools
Armstrong Bros. Tool Co.
Lovejoy Tool Co., Inc.

LATHES, Automatic and Semi-Automatic
Bullard Co.
Jones & Lamson Mach. Co.
LeBlond Mach. Tool Co., R. K.
Lodge & Shipley Mach. Tool Co.
National Acme Co.
Potter & Johnston Mch. Co.
Pratt & Whitney Co.
Reed-Prentice Corp.
Seneca Falls Machine Co.
Sundstrand Mach. Tool Co.

LATHES, Axle R.R.
Sellers & Co., Wm.

LATHES, Bench
Hardinge Bros.
Hjorth Lathe & Tool Co.
Pratt & Whitney Co.
Rivett Lathe & Grinder Corp.
Seneca Falls Machine Co.
South Bend Lathe Works

LATHES, Engine
American Tool Works Co.
Boye & Emmes Machine Tool Co.
Consolidated Mach. Tool Corp of America
Flather Co. (The)
LeBlond Mach. Tool Co., R. K.
Lodge & Shipley Mach. Tool Co.
Monarch Mach. Tool Co.
Morris Machine Tool Co.
Pratt & Whitney Co.
Reed-Prentice Corp.
Ryerson & Son, Jos. T.
Seneca Falls Machine Co.
South Bend Lathe Works
Springfield Mch. Tool Co.
Sundstrand Mach. Tool Co.
Wickes Bros.

LATHES, Horizontal and Vertical Turret
Brown & Sharpe Mfg. Co.
Bullard Co.
Jones & Lamson Mach. Co.
Pratt & Whitney Co.

LATHES, Spinning
Adriance Mach. Works

LATHES, Toolroom
American Tool Works Co.
Hardinge Bros.
LeBlond Mach. Tool Co., R.K.
Lodge & Shipley Mach. Tool Co.
Pratt & Whitney Co.
Reed-Prentice Corp.
South Bend Lathe Works
Sundstrand Mach. Tool Co.

LATHES, Wheel, R. R.
Sellers & Co., Wm.

LEVEL Precision Machines, Aligning
Ferner Co., R. Y.
Universal Bor. Mach. Co.

LINING, Brake and Clutch
Raybestos Manhattan Inc.

LUBRICANTS
Alemite Corp.
Oakite Products

LUBRICATING Systems
Alemite Corp.
Rivett Lathe & Grinder Corp.

LUGS, Soldering and Terminal
Wolverine Tube Co.

MAGNETS, Lifting
Ohio Elec. & Mfg. Co.

MARKING Machines
Noble & Westbrook Mfg. Co.
Preis & Co., H. P.

MEASURING Instruments
Ferner Co., R. Y.
Hanson-Whitney Machine Co.
Norma Hoffman Bearings Corp.

MELTING Pots
Hones, Chas. A.

MICROMETERS
Brown & Sharpe Mfg. Co.
Ferner Co., R. Y.
Pratt & Whitney Co.
Starrett Co., L. S.

MILLING Attachments
Adams Co.
Brown & Sharpe Mfg. Co.
Cincinnati Milling Mach Co.
Ingersoll Milling Mach. Co.
Kearney & Trecker Corp.
Potter & Johnston Mch. Co.
Reed-Prentice Corp.
Sundstrand Mach. Tool Co.

MILLING Machines, Automatic
Brown & Sharpe Mfg. Co.
Cincinnati Milling Mach Co
Ingersoll Milling Mach. Co.
Kearney & Trecker Corp.
Pratt & Whitney Co.
Sundstrand Mach. Tool Co.

MILLING Machines, Bench
Hardinge Bros.
Pratt & Whitney Co.
Sundstrand Mach. Tool Co.

MILLING Machines, Continuous
Consolidated Mach. Tool Corp. of America
Ingersoll Milling Mach. Co.
Kearney & Trecker Corp.
Potter & Johnston Mch. Co.
Sundstrand Mach. Tool Co.

MILLING Machines, Duplex
Brown & Sharpe Mfg. Co.
Cincinnati Milling Mach. Co
Ingersoll Milling Mach. Co.
Kearney & Trecker Corp.

MILLING Machines, Floor Plate
Sellers & Co., Wm.

MILLING Machines, Hand
Brown & Sharpe Mfg. Co.
Cincinnati Milling Mach. Co.
Pratt & Whitney Co.
Sundstrand Mach. Tool Co.

MILLING Machines, Plain
Brown & Sharpe Mfg. Co.
Cincinnati Milling Mach. Co.
Ingersoll Milling Mach. Co.
Kearney & Trecker Corp.
Potter & Johnston Mach. Co.
Sundstrand Mach. Tool Co

MILLING Machines, Planer Type
Consolidated Mach. Tool Corp of America
Ingersoll Milling Mach. Co.
Kearney & Trecker Corp.
Sellers & Co., Wm.

MILLING Machines, Portable
Ingersoll Milling Mach. Co.

MILLING Machines, Thread
Adams Co.
Hanson-Whitney Machine Co.
Pratt & Whitney Co.
Waltham Mach. Works

MILLING Machines, Traveling Work Table
Sellers & Co., Wm.

MILLING Machines, Universal
Brown & Sharpe Mfg. Co.
Cincinnati Milling Mach. Co.
Ingersoll Milling Mach. Co.
Kearney & Trecker Corp.
Potter & Johnston Mch. Co.
Ryerson & Sons, Jos. T.
Sundstrand Mach. Tool Co.

MILLING Machines, Vertical
Brown & Sharpe Mfg. Co.
Cincinnati Milling Mach. Co.
Consolidated Mach. Tool Corp. of America
Gorton Mach. Co., Geo.
Ingersoll Milling Mach. Co.
Kearney & Trecker Corp.
Potter & Johnston Mch. Co.
Reed-Prentice Corp.
Sundstrand Mach. Tool Co.

MILLING Machines, Worm
Cleveland Auto. Mach. Co.
Pratt & Whitney Co.
Waltham Mach. Works

MOTORS, Electric
Ohio Elec. & Mfg. Co.
Westinghouse Elec. & Mfg. Co.

NUMBERING Machines
Noble & Westbrook Mfg. Co.
International Nickel Co.

NUT Setters, Pneumatic and Electric
Cincinnati Electrical Tool Co.

NUTS, Castellated
National Acme Co.

OIL and Grease Cups
Alemite Corp.
Gits Bros. Mfg. Co.

OIL Burning Systems, Fuel
Chicago Flexible Shaft Co.

OIL Filters
Cuno Engrg. Co.

OIL Grooving Machines
Hanson-Whitney Mach. Co.

OIL Stones
Norton Co.

OILS
(See Lubricants)

PAINTS & Finishes, Industrial
Du Pont de Nemours & Co., Inc., E. I.

PARALLELS
Starrett Co., L. S.

PATTERN Shop Machinery
(See Woodworking Machinery)

PILLOW Blocks
Standard Pressed Steel Co.

PIPE Cutting and Threading Machines
Landis Mach. Co.
Murchey Mach. & Tool Co.

PIPE Fitters' Tools
Butterfield & Co.

PLANING Machines
American Tool Works Co.
Cleveland Planer Co.
Consolidated Mach. Tool Corp of America
Gray Co., G. A.
Ryerson & Son, Jos. T.
Sellers & Co., Wm.

POLISHING and Buffing Machines
Barnes Co., W. F. & John
Bryant Chucking Grinder Co.
Cincinnati Electrical Tool Co.
Heald Machine Co.
New Britain Gridley Mch. Co.
Union Twist Drill Co.

POLISHING and Buffing Machines, Portable
Cincinnati Electrical Tool Co.

PORTABLE Tools
Cincinnati Electrical Tool Co.

PRESS Feeds
Littell Mach. Co., F. J.
V. & O. Press Co.

PRESSES, Arbor
Barnes Co., W. F. & John
Nicholson & Co., W. H.

PRESSES Drop Forging
Bliss C., E. W.
Niagara Mach. & Tool Wks.
Toledo Machine & Tool Co.

PRESSES, Foot and Hand
Adriance Mach. Works, Inc.
Bliss Co., E. W.
Ferracute Machine Co.
Niagara Mach. & Tool Works
Taylor & Fenn Co.

PRESSES, Forcing
Barnes Co., W. F. & John
Elmes Eng. Works, Chas. F.
Watson-Stillman Co.

PRESSES, Hydraulic
Elmes Eng. Works, Chas. F.
Watson-Stillman Co.

PRESSES, Power
Adriance Mach. Works
Barnes Co., W. F. & John
Bliss Co., E. W.
Ferracute Machine Co.
Henry & Wright Mfg. Co.
Niagara Mach. & Tool Works
Toledo Machine & Tool Co.
V & O Press Co.

PRESSES, Screw
Barnes Co., W. F. & John
Bliss Co., E. W.

PROFILING Machines
Gorton Mach. Co., Geo.

PULLEYS, Metal
Johnson Mach. Co., Carlyle

PUMPS, Hydraulic & Power
Buffalo Forge Co.
Elmes Eng. Wks., Chas. F.
Watson-Stillman Co.

PUMPS, Lubricant and Oil
Brown & Sharpe Mfg. Co.

PUMPS, Portable
National Acme Co.

PUNCHES, Center and Hand
Armstrong-Blum Mfg. Co.
Starrett Co., L. S.

PUNCHES, Power
Buffalo Forge Co.
Ferracute Machine Co.
Niagara Mach. & Tool Works

PUNCHING and Shearing Machines
Buffalo Forge Co.
Cleveland Twist Drill Co.
Consolidated Mach. Tool Corp. of America
Gammons-Holman Co.
Morse Twist Drill & Mach. Co.
National Tool Co.
Ryerson & Son, Jos. T.
Union Twist Drill Co.
Wickes Bros.

PYROMETERS, Electric
Wilson-Maeulen Co.

RACKS, Storage
(See Furniture Machine Shop)

REAMERS, Adjustable
Barber-Colman Co.
Gammons-Holman Co.
Pratt & Whitney Co.

REAMERS Solid
Barber-Colman Co.
Pratt & Whitney Co.

RHEOSTATS
Westinghouse Elec. & Mfg. Co.

RIVET Making Machinery
National Machinery Co.

RIVETING Machines
Grant Mfg. & Machine Co.
High Speed Hammer Co.

RULES, Steel and Wood
Starrett Co., L. S.

RUST Preventatives
Oakite Products

SAWING Machines, Band
Armstrong-Blum Mfg. Co.

SAWING Machines, Power Hack
Armstrong-Blum Mfg. Co.
Earle Gear & Machine Co.
Peerless Machine Co.
Racine Tool & Mach. Co.

SAWS, Hack, Frames and Blades
American Saw & Mfg. Co.
Armstrong-Blum Mfg. Co.
Racine Tool & Mach. Co.
Starrett Co., L. S.

SAWS, Milling
Barber-Colman Co.
National Tool Co.
Union Twist Drill Co.

SAWS, Screw Slotting
Starrett Co., L. S.
Union Twist Drill Co.

SCALES
Starrett Co., L. S.

SCRAPING Mchs. & Attachments
Anderson Bros. Mfg. Co.

SCREW Drivers, Automatic
Errington Mech. Laboratory

SCREW-DRIVERS, Portable Electric and Pneumatic
Cincinnati Electrical Tool Co.

SCREW-Machine Work
Eastern Mch. Screw Corp.
Morris Machine Tool Co.
National Acme Co.
New Britain Bridley Mch. Co.

SCREW Machines, Automatic
Brown & Sharpe Mfg. Co.
Cleveland Auto. Mach. Co.
Cone Auto. Mch. Co.
National Acme Co.
New Britain Gridley Mch. Co.

SCREW Machines, Plain or Hand
Brown & Sharpe Mfg. Co.
Cleveland Auto. Mach. Co.
Jones & Lamson Mach. Co.
Pratt & Whitney Co.

SCREW Plates
Card Mfg. Co.

SCREWS, Cap and Set
Allen Mfg. Co.
Cleveland Cap. Screw Co.
Danly Machine Specialties, Inc.
Eastern Mch. Screw Corp.
National Acme Co.
Standard Pressed Steel Co.
Strong, Carlisle & Hammond Co.

SCREWS, Machine
Allen Mfg. Co.
Eastern Mch. Screw Corp.
National Acme Co.

SCREWS, Safety
Strong, Carlisle & Hammond Co.

SECOND-HAND Machinery
(See Searchlight Section)
De Witt Tool Co.
Emerman Co., Louis E.
Essley Mchy. Co.
Freeman & Co., Samuel T.
General Mchy. Corp.
Hill Clarke & Co.
Hyman & Sons, J.
Indianapolis Mchy. Co.
Miles Machy. Co.
Morey & Co.
Osborne & Sexton Mchy. Co.
Palmer-Edwards Co.
Simmons Mach. Tool Corp.

SEPARATORS, Centrifugal
National Acme Co.

SEPARATORS, Magnetic
Ohio Elec. & Mfg. Co.

SEPARATORS, Oil and Waste
Barrett, Leon J.

SHAFTING
Ryerson & Son, Jos. T.
Strand & Co., N. A.

SHAFTS, Flexible
Haskins, R. G. Co.
Strand & Co., N. A.

SHAPERS
American Tool Works Co.
Hanson-Whitney Machine Co.
Potter & Johnston Mach Co.
Pratt & Whitney Co.
Ryerson & Son, Jos. T.
Smith & Mills Co.
Springfield Machine Tool Co.

SHEARS, Power
Adriance Mach. Works
Buffalo Forge Co.
Consolidated Mach. Tool Corp. of America
Ferracute Machine Co.
Niagara Mch. & Tool Works
Toledo Machine & Tool Co.

SHEET Metal Working Machinery
Adriance Mach. Works
Bliss Co., E. W.
Feracute Machine Co.
Niagara Mch. & Tool Works
Ryerson & Son, Jos. T.
Toledo Machine & Tool Co.

SLOTTING Machines
Consolidated Mach. Tool Corp. of America
Sellers & Co., Wm.

SPECIAL Machinery
(See Contract Work)

SPEED Box, Motor Drive
Rivett Lathe & Grinder Corp.

SPEED Reducers
Adams Co.
Boston Gear Works Sales Co
Earle Gear & Machine Co.
Grant Gear Works
Hartford Special Machy. Co.
Philadelphia Gear Works

SPRING Winders
Hjorth Lathe & Tool Co.

SPROCKETS
Baldwin-Duckworth Chain Corp.
Bilgram Mach. Works
Boston Gear Works Sales Co.
Cullman Wheel Co.
Grant Gear Works
Philadelphia Gear Works

SQUARES
Starrett Co., L. S.

STAMPING Attachment, Press
Marquette Tool & Mfg. Co.

STAMPINGS, Metal
Detroit Stamping Co.
Standard Pressed Steel Co.

STAMPS, Steel
Noble & Westbrook Mfg. Co.

STEEL, Rustless & Stainless
Carpenter Steel Co.

STEELS, Alloy, Carbon and High Speed
Carpenter Steel Co.
Hawkridge Bros. Co.
Latrobe Electric Steel Co.
Ryerson & Son, Jos. T.
Timken Roller Bearing Co.
Vanadium-Alloys Steel Co.

STRAIGHTENING Machinery
Springfield Mch. Too. Co.

STUD Setters
Errington Mech. Laboratory

SUBPRESSES and Dies
Danly Mach. Spec., Inc.
U. S. Tool Co.
Waltham Mach. Works

SWAGING Machines
Langelier Mfg. Co.
Torrington Co.

SWITCHES and Controllers, Electric
Shepard Niles Crane & Hoist Corp.

TAP Extensions
Allen Mfg. Co.

TAP Extractors, Broken
Walton Co.

TAP Holders
Errington Mech. Laboratory

TAPES, Measuring
Starrett Co., L. S.

TAPPING Machines and Attachments
Acme Machinery Co.
American Tool Works Co.
Baker Bros.
Barber-Colman Co.
Barnes Drill Co., Inc.
Errington Mech. Laboratory
Ettco Tool Co.
Geometric Tool Co.
Kingsbury Machine Tool Corp.
Moline Tool Co.
Murchey Mach. & Tool Co.
National Machinery Co.

TAPS and Dies
Card Mfg. Co., S. W.
Hanson-Whitney Machine Co.
Landis Mach. Co.
Murchey Mach. & Tool Co
National Acme Co.
National Tool Co.
Pratt & Whitney Co.

TAPS, Collapsing
Geometric Tool Co.
Landis Mach. Co.
Murchey Mach. & Tool Co.
National Acme Co.

TAPS, Ground
Hanson-Whitney Mach. Co.
Jones & Lamson Mach. Co.

TEMPERATURE Controllers, Automatic
Wilson-Maeulen Co.

TESTING Apparatus, Hardness
Shore Instrument & Mfg. Co.
Wilson-Maeulen Co.

THREAD-Cutting Machines
Brown & Sharpe Mfg. Co.
Eastern Mch. Screw Corp.
Ferner Co., R. Y.
Geometric Tool Co.
Grant Mfg. & Mach. Co.
Landis Mach. Co.
Murchey Mach. & Tool Co.
National Machinery Co.

THREAD-Cutting Tools
Eastern Mch. Screw Corp.
Geometric Tool Co.
Hanson-Whitney Machine Co.
Jones & Lamson Mach. Co.
Landis Mach. Co.
Murchey Mach. & Tool Co.
National Acme Co.

THREAD Rolling Machines
National Machinery Co.

TOOL Bits
Vanadium-Alloys Steel Co.

TOOL Holders
Armstrong Bros. Tool Co.
Lovejoy Tool Co., Inc.

TOOL Posts, Lathe
Armstrong Bros. Tool Co.

TOOLS, Cutting-off
Armstrong Bros. Tool Co.

TOOLS, Diamond
Desmond-Stephan Mfg. Co.

TRANSFORMERS
Westinghouse Elec. & Mfg. Co.
Whitney Mfg. Co.

TRANSMISSION Equipment
Baldwin-Duckworth Chain Corp.

TRUCKS, Shop Power
Baker-Raulang Co.

TUBES and Tubing, Copper, Brass, etc.
Timken Roller Bearing Co.
Wolverine Tube Co.

TURBINES, Steam
Westinghouse Elec. & Mfg. Co.

TURRET Machines
(See Lathes, Horizontal Turret)

TURRETS, Tool Post
American Tool Works Co.

UNIONS, Pipe
Dart Mfg. Co., E. M.

VALVES
Elmes Eng. Works, Chas. F.

VISE Stands
New Britain Gridley Mch. Co.

VISES, Drilling Machine
Armstrong-Blum Mfg. Co.
Armstrong Bros. Tool Co.
Barber-Colman Co.
Brown Eng. Co.
Hartford Special Machy. Co
United States Automatic Box Machinery Co.

VISES, Milling Machine
Brown & Sharpe Mfg. Co.
Cincinnati Milling Mach. Co.
Hartford Special Mach. Co.
United States Automatic Box Machy. Co.

WASHERS, Plain
Detroit Stamping Co.

WASHING and Drying Machines, Metal Parts
Barrett, Leon J.
Colts Patent Fire Arms Mfg. Co.

WELDING Machines, Electric
Federal Mach. & Welder Co
Thomson-Gibb Electric Welding Co.
Westinghouse Elec. & Mfg. Co.
Wilson & Welder & Metals Co.

WELDING Supplies
Wilson & Welder & Metals Co.

WOOD Working Machy.
Barnes Co., W. F. & John
Seneca Falls Machine Co.

WORM Drives
Hartford Special Mach. Co.

WRENCHES, Drop Forged
Armstrong Bros. Tool Co.

WRENCHES, Ratchet
Card Mfg. Co., S. W.
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WRENCHES, Tap
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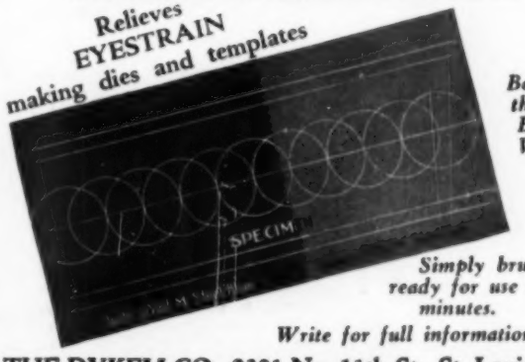

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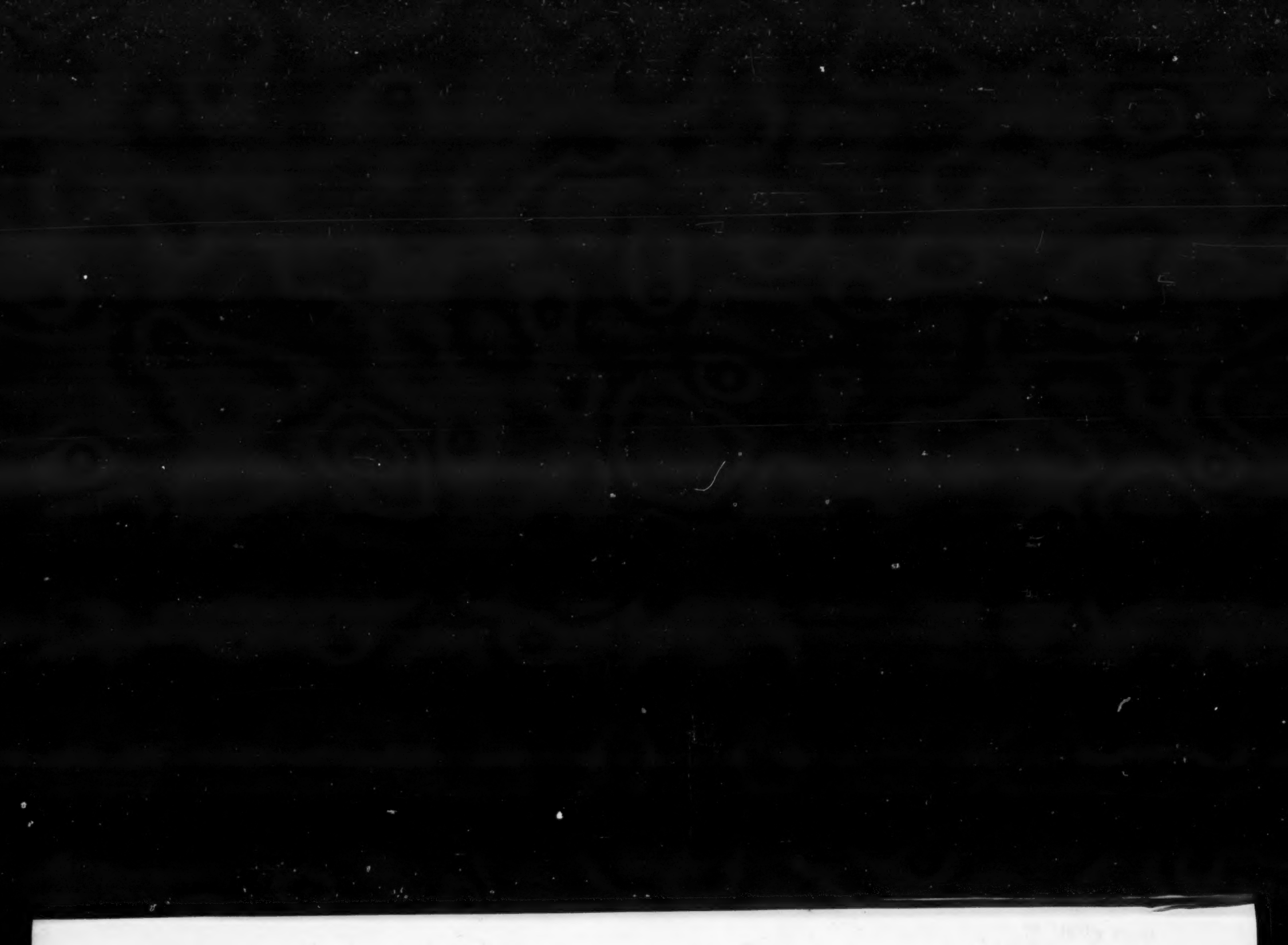
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